

BRUSH CREEK
HAYHURST VALLEY
YONCALLA

Watershed Analysis

First Iteration
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BRUSH CREEK - HAYHURST VALLEY - YONCALLA WATERSHED ANALYSIS

01 NOVEMBER 1995

I. INTRODUCTION

Watershed analysis is being undertaken on the Brush Creek, Hayhurst Valley, and Yoncalla watershed analysis units [*hereafter referred to collectively as BHY WAU*] as prescribed in the Standards and Guidelines for Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl (USDA and USDI 1994).

Watershed analysis is the gathering of information on and the description of the physical and biological processes that are active within and between watersheds. Analysis units range between 20 and 200 square miles. The results of this watershed analysis will be utilized to make informed management decisions and to identify specific projects that are compatible with the goals and objectives identified in the S&Gs for the benefit of the natural resources and the people dependent upon them. An interdisciplinary (ID) team (Appendix 1) has been established to conduct the analysis of the BHY WAU.

The Record of Decision and Resource Management Plan for the Roseburg District of the Bureau of Land Management identified three dominant land use allocations (LUAs) within the analysis area; General Forest Management Area (GFMA), Connectivity (CONN), and Late Successional Reserve, elements 1 and 2 (LSR) (Table I.1, Figure I.1).

Table I.1. Land use allocations within the BHY WAU.		
Land Use Allocation	Size (ac.)	Percent (%)
General Forest Management Area	5647	42
Connectivity	963	7
Late Successional Reserve	6698	50
Total	13,308	

General forest management areas (GFMAs) will be managed using intensive forest management practices to maintain long term site productivity, biological legacies, and a biologically diverse matrix. Connectivity (CONN) will be managed to provide for movement, dispersal, and connectivity of plant and animal species; limited commercial productivity; and to maintain ecotypic richness and diversity in the matrix. Mapped and unmapped Late Successional Reserves (LSRs) have been established to protect and enhance conditions of late-successional and old-growth forest ecosystems, which serve as habitat for late-successional and old-growth forest related species including the northern spotted owl (Strix occidentalis caurina) and the marbled murrelet (Brachyramphus marmoratus).

Overlaying the GFMA and CONN is a network of riparian reserves. Riparian reserves are one of four components of the Aquatic Conservation put forth in USDA and USDI (1994). The other three components are Key Watersheds, Watershed Analysis, and Watershed Restoration.

Management within the riparian reserves will be aimed at promoting the development of late-successional and old-growth forest. Riparian reserves are designed to "maintain and restore riparian structures and functions of intermittent streams, confer benefits to riparian-dependent and associated species other than fish, enhance habitat conservation for organisms that are dependent on the transition zone between upslope and riparian areas, improve travel and

dispersal corridors for many terrestrial animals and plants, and provide for connectivity of the watershed." (USDA and USDI 1994:B-13).

I.1 Location of BHY WAU

The BHY WAU lies in the northern portion of the Roseburg District; south of Elk Creek, between the towns of Drain and Elkton (Figure I.2). The analysis area is comprised of three watershed analysis units and consists of 13,308 acres of federally managed lands and 37,121 acres of private lands (Table I.2). Major private landowners include Juniper Properties, Bear Creek Timber Company, Weyerhaeuser Company, and International Paper Company. Within the analysis area there are 16 small, watershed sub-basins (Figure I.3).

Table I.2. Size of the BHY WAU.						
Watershed Analysis Unit	Federal Lands		Private Lands		Total	
	(ac.)	(%)	(ac.)	(%)	(ac.)	(%)
Brush Creek	7915	16	7172	14	15087	30
Hayhurst Valley	4289	9	12126	24	16415	33
Yoncalla	1104	2	17823	35	18928	38
Total	13,308	27	37,121	73	50,430	

I.2 Fire History

The fire return interval for the moist, Coast Range forest of the BHY WAU may be greater than 150 years (Agee 1993). Agee (1981, as cited in Agee 1990) identified six fire regimes, BHY WAU is likely to contain components of two of these regimes.

Fire regime 5: Long return interval crown fires and severe surface fires in combination (100-300 year return interval).

Fire regime 6: Very long return interval crown fires and severe surface fires in combination (over 300 year return interval)

A second system of fire regime classification is based on the effects of fires on dominant vegetation, from low to high fire severity (Agee 1990). With this system, the BHY WAU would be classified as having a high severity fire regime. High severity fires can remove 70 percent or more of their basal area. Douglas-fir has the ability to resist damage by fire, due to the extremely thick bark of larger trees. As a result, many of the existing natural stands in the WAU may appear as a mosaic or patch work of areas of old growth and scattered patches of mature and younger stands of even-aged conifers. On any site all levels of fire severity will be present, scattered over space and time.

1914 Oregon State Forest Type Map

In 1914, Oregon State Forester, F.A. Elliott commissioned development of a map of the state's forestland. This map was to illustrate the extent of prehistoric and historic forest fires, commercial timber stands, burned areas successfully reforested, and burned areas not reforested (Table I.3, Figure I.4). Hypothetical description of the vegetation are provide for these areas based on our knowledge of fire behavior, fire effects, forestry and cultural history.

This WAU is dominated by private lands in the east (many small parcels), and BLM managed lands in the western portion. The vast majority of BLM lands were classified as merchantable timber. Much of the private land, specifically in the Yoncalla area was determined to be brush land or non-timbered areas. There is no distinction between mature timber (old growth) and younger stands of merchantable size. It is highly unlikely that the area classified as merchantable timber was a continuous block of "old growth" timber. It is likely that most of the timber stands present in the WAU originated from stand replacement fires. Man caused and lightning caused fires (the result is the same) have likely been the dominant natural disturbance in this area for hundreds, perhaps thousands of years before white settlement. Humans have lived here as family units for at least 11,000 years.

The areas classified as "burned areas not re-stocking" are estimated to have had a stand

replacement fire that occurred 10-15 years earlier (Figure I.4). Many large fires occurred around the turn of the century. Approximately 6 percent of the BHY WAU was determined to be in this classification. These burned areas were probably the result of severe surface and crown fires. "Early season crown fires, or crown scorch fires in poor seed years, may be associated with a lack of early regeneration after a fire" (Agee 1993). In Coast Range forests, tree recruitment or re-establishment can take 50 years or more. Because of this, the fire that caused these burns may have occurred in the 1870's.

The areas classified as brush could have resulted from stand replacement fires that consumed the entire tree canopy (Figure I.4). Repeated burning by Native Americans may have eventually consumed all the conifers in these foothill areas. Perhaps there was no canopy to burn. The area may have been brush before. Regardless of the previous vegetation, this fire burned with high intensity leaving no seed source for conifer re-establishment. Brush sprouted from below ground adventitious buds and completely occupied the site. More recently, many of these areas have become reforested either naturally, or by conversion of brush to conifer stands.

The area classified as non-timber is mostly in the Yoncalla Valley and the surrounding foothills (Figure I.4). This area was likely grassland with a few scattered large trees, the result of repeated burning over long periods of time. The Native Americans used fire to improve forage for game animals and to improve habitat conditions for food and medicinal plants. Grasslands were burned in the summer. It must be assumed that some of these fires burned more than just the grasslands and sometimes resulted in the stand replacement fires shown on the 1914 map, perhaps creating "brush areas". Fires are known to have burned all summer until the fall rains extinguished them. "In all the low valleys of the Umpqua there was very little undergrowth, the annual fires set by the Indians preventing young growth of timber." (George Riddle 1851, as cited in Zybach 1994).

District records identified 6 fires within the WAU, on BLM managed lands, burning a total of 7 acres, having occurred since 1980. The most common cause of fires, on BLM lands, was lightning.

I.3 Issues

The ID team identified a large number of areas of concern. They were then able to condense that list into 5 key issues (listed are some concern that might be addressed with each issue):

WATER --

- bank stability
- chemical and physical stream parameters
- non-point source pollution
- sedimentation --
 - road drainage
 - erosion
 - skid trails
 - road density
- water quantity
- municipal watersheds
- riparian condition

FISH --

- species occurrence
- habitat condition
- passage

VEGETATIVE CONDITION --

- commodity production
- LSR condition
- riparian reserve condition
- noxious weeds
- special status species (T&E, S&M, buffered species)
- fuel loading

connectivity
agricultural lands
soil productivity

CULTURAL --

illegal dumping
law enforcement
acquisition
partnerships
fire
recreation
archeological/historical

WILDLIFE --

special status species (T&E, S&M)
neotropical birds
game species
critical habitats (NSO & MM)

The following sections will look at each issue and discuss the present conditions and analyze the key questions.

II. WATER

II.1 Introduction

The Brush, Hayhurst, and Yoncalla (BHY WAU) watersheds are all sixth order streams that flow into Elk Creek which is a seventh order stream. Brush and Yoncalla watersheds are named after the main tributary, Billy Creek is the main tributary of the Hayhurst watershed. The watersheds have been divided into 16 watershed compartments ranging in size from about 1,247 to 5,729 acres, select characteristics are presented in Table II.1. The Brush Creek watershed includes frontal drainage of about 1,655 acres consisting of small creeks flowing directly into Elk Creek. The Brush Creek watershed, excluding the Elk Creek frontal, ranges in elevation from 160 ft at the Elk Creek confluence to 2,456 ft at the peak of Yellow Butte. The Hayhurst watershed ranges in elevation from 280 ft at the confluence of Elk and Billy Creeks to 2,320 ft at the head of Andrews Creek, near the peak of Prince Albert. The Yoncalla watershed ranges in elevation from 320 ft at the Elk Creek confluence to 1,800 ft at an unnamed peak on the west headwaters of Huntington Creek.

The Roseburg District BLM has a Memorandum of Understanding with the City of Drain for the Bear Creek Municipal Watershed. This watershed includes the entire Bear Lake and Bear Creek compartments (Figure I.2), comprising 2,878 and 1,423 acres. The objective of this agreement is to maintain the best water quality for the City of Drain Water System via Best Management Practices to control non-point sources of pollution. The system provides domestic water for approximately 1,200 users near Drain. The source of water is Bear, Allen and Lost Cabin Creeks.

Table II.1. Watershed characteristics in GIS, changes based on 1994 aerial photos and field observations in parenthesis.

Compartment or Watershed	Area Acres Mi ²	Percent Sub WAU	Road Mi	Rd. Density Mi/Mi ²	Stream Miles	Drainage Density	Roads/strs. %	Stream Order
Elk Overpass	1,655 2.59	11.0 3.3	9.70 (13.74)	3.75 (5.31)	18.44	7.12	52.6 (74.5)	7 th
Lower Thistle	1,247 1.95	8.3 2.5	10.40 (12.48)	5.33 (6.40)	12.48	6.40	83.3 (100)	6 th
Thistleburn Ck.	3,001 4.69	19.9 6.0	23.82 (24.44)	5.08 (5.21)	27.56	5.87	86.4 (88.7)	5 th
Squaw Brush	2,493 3.89	16.5 4.9	17.84 (20.98)	4.59 (5.39)	21.91	5.63	81.4 (95.6)	5 th
Blue Brush	4,193 6.55	27.8 8.3	31.57 (33.82)	4.82 (5.16)	40.81	6.23	77.4 (82.9)	5 th
Lower Brush	2,507 3.92	16.6 4.9	4.97 (11.04)	1.27 (2.82)	24.88	6.35	19.9 (44.4)	6 th
Brush Creek	15,096 23.6	100.0 29.9	98.30 (116.50)	4.17 (4.94)	146.08	6.19	67.3 (79.8)	6 th

Table 11.1. Watershed characteristics in GIS, changes based on 1994 aerial photos and field observations in parenthesis.

Compartment or Watershed	Area Acres Mi ²	Percent Sub WAU	Road Mi	Rd. Density Mi/Mi ²	Stream Miles	Drainage Density	Roads/strs. %	Stream Order figures and
Bear Lake	2,878 4.50	17.5 5.7	22.71 (25.60)	5.05 (5.69)	27.91	6.20	81.4 (91.7)	4 th
Bear Creek	1,423 2.23	8.7 2.8	15.00	6.73	12.62	5.63	118.9	5 th
Billy Creek	5,371 8.39	32.7 10.6	52.14 (54.77)	6.21 (6.53)	46.50	5.54	112.1 (117.8)	6 th
Flagler Canyon	2,953 4.61	17.9 5.8	22.65 (30.55)	4.91 (6.63)	31.15	6.76	72.7 (98.1)	5 th
Andrews Creek	3,801 5.94	23.1 7.5	27.95 (33.41)	4.71 (5.62)	36.22	6.10	77.2 (92.2)	5 th
Hayhurst	16,426 25.7	100.0 32.4	140.25 (159.33)	5.47 (6.20)	154.40	6.01	91.0 (103.2)	6 th

Table II.1. Watershed characteristics in GIS, changes based on 1994 aerial photos and field observations in parenthesis.

Compartment or Watershed	Area Acres Mi ²	Percent Sub WAU	Road Mi	Rd. Density Mi/Mi ²	Stream Miles	Drainage Density	Roads/strs. %	Stream Order
Huntington Ck.	2,861 4.47	15.1 5.7	26.04 (28.96)	5.83 (6.48)	27.24	6.09	95.6 (106.3)	4 th
Devore Mnt.	4,765 7.45	25.2 9.4	49.62 (53.45)	6.66 (7.17)	43.95	5.90	112.9 (121.6)	6 th
Halo Creek	3,427 5.35	18.1 6.8	21.10 (25.36)	3.94 (4.74)	32.57	6.09	64.8 (77.9)	6 th
Cowan Creek	2,158 3.37	11.4 4.3	27.55 (29.55)	8.18 (8.77)	19.66	5.83	140.1 (150.3)	4 th
Rice Hill	5,729 8.95	30.3 11.4	62.27 (65.08)	6.96 (7.27)	42.70	4.77	145.8 (152.4)	5 th
Yoncalla	18,940 29.6	100.0 37.6	186.58 (202.40)	6.31 (6.84)	166.12	5.61	112.3 (121.8)	6 th
BHY WAU	50,461 78.9	n/a 100.0	425.33 (478.23)	5.39 (6.06)	466.6	5.91	91.2 (102.5)	7 th

The BHY WAU has a mediterranean type of climate, characterized by cool, wet winters and hot, dry summers. Weather stations used to estimate precipitation and temperature for the WAU are Drain to the east at an elevation of 292 ft and Elkton to the west at an elevation of 120 ft. They are NOAA weather stations and were selected because they are close to the study area and they have long term data available. The climate data presented are 1961-90 mean data from Owenby and Ezell (1992). Annual precipitation ranges from 46 inches at Drain to 53 inches at Elkton, about 85% occurs from October to April; summer precipitation averages about 6 inches. Normal summer maximum temperature is typically in the low 80's °F and normal winter minimum temperature is in the mid 30's °F. Precipitation is known to be dependent on elevation due to orographic effects. Annual precipitation in the BHY WAU probably ranges from 50 inches at the outlets to Elk Creek to 70 inches at the upper most elevations. Precipitation occurs mostly as rainfall since little of the study area is above 2000 ft.

II.2 Desired Future Conditions:

Provide for the maintenance of existing water standards and improvement of degraded waters in compliance with the clean Water Act and the Aquatic Conservation Strategy.

II.3 Key Question:

What was the contributing factors to the existing water quality and what can be done to maintain or improve water quality?

II.3.1 Erosion processes

Surface erosion and landslides are natural cyclic processes we find in the BHY WAU that strongly influence hydrologic patterns and water quality. The types of surface erosion include: rill and gully (channelized erosion); sheet erosion (non channelized overland flow), and soil creep or ravel (moved by gravity). Surface erosion increases on hillslopes where soils are exposed or compacted and lose their ability to absorb water (infiltration) or where natural

drainage is disrupted. Soil compaction can be significant when tractors operate. Fine textured soils are most sensitive to compaction. Livestock grazing and intense fire can also reduce the soil infiltration capacity.

Large wood is extremely important in these low gradient systems that contain an abundant source of fine sediment. Log jams, and to a lesser extent, individual pieces of large wood, act as a source of roughness that traps sediment and helps to moderate its progression down a given stream channel. In streams with extremely high sediment loads, the few areas of quality spawning gravel are often only found in association with these wood formations. Much of the wood naturally found in these systems has been on site for many years. The combination of a wide valley bottom, low gradient and meandering channel result in a system that tends to retain its large wood, rather than wash it downstream.

There are 478 miles of roads in the BHY WAU, 425 miles of roads are digitized in GIS (Table II.1). Added erosional effects can occur when culverts plug or fail to handle peak flows, causing streams to divert out of their original channel flow down the road grade and enter the channel of another stream. Only culverts with drainage areas greater than 100 acres are necessary for the assessment for their ability to carry a variety of peak flows. Stream discharges for flood events of any recurrence interval can be calculated for any drainage area not included in this text. Erosion of road surfaces varies greatly with the type and amount of traffic, season of use, and the type and quality of road surface material (Reid and Dunne, 1984). Other variables are road gradients, effectiveness of drainage features, quality of road maintenance programs and soil and bedrock characteristics. For this watershed analysis not all roads were inventoried for their potential to produce sediment at stream crossings (Refer to soil scientist's report, pages C-11 to C-14, in appendix A.).

The mass movement of soils by landslides (debris avalanches, debris flows, and earthflow and slumps) is a major component of hillslope erosion and sediment transport to streams in mountain areas. Landslide distribution, frequency, and magnitude are controlled by the following: 1) slope steepness, 2) amount of subsurface water, 3) degree and depth of bedrock

weathering, 4) presence of concave landforms that serve to concentrate ground water and accumulate sediment deposits, and 5) relationship of these landforms with downslope stream channels (Swanson, 1991). The dip of rock strata and soil strengths may also be important factors. Landslides are generally initiated by unusual weather events such as intense winter storms, rapid snowmelt, or prolonged periods of rain. They increase dramatically following intense wildfire, timber harvest, road building, or during earthquakes. In general, steeper slopes have a higher potential for ground failure and sediment input to streams tends to be higher in rain dominated rather than snow dominated areas (Swanson, 1991). Refer to soil's report, Appendix A, pages C-2 to C-6, for landslide frequency.

II.3.2 Streamflow

Streamflow have not been monitored in the BHY WAU. Streamflow data were collected on Elk Creek near Drain (station no. 14322000) for water years 1956 to 1973. The gage was at an elevation of 306 ft, 1.7 mi southeast of Drain, 0.2 mi downstream from Yoncalla Creek, with an upstream drainage area of 104 mi². Streamflow for this site was probably greater than the individual BHY watersheds because it's drainage area is about four times the size of the individual BHY watersheds and it may receive more rainfall due to higher elevations.

However, data from this gage is being used to characterize streamflow for BHY WAU because it is close to the study area, has a long period of record, and no other data are known to exist. According to Moffatt et. al (1990) the average discharge for 18 years on Elk Creek was 222 ft³/s (165,900 acre-ft/yr); 97.6% occurred from November through May, and no flow occurred at times. Maximum discharge was 15,000 ft³/s February 10, 1961; the gage height was 23.7 ft. The average percent of annual runoff ranges from 23.2% for January to 0.1% for August and September. The flood frequency for this site determined by Friday and Miller (1984) is presented in Table II.2. They did not estimate recurrence intervals of 50 and 100 years because the period of record was not long enough.

Table II.2. Magnitude and probability of instantaneous peak flow for Elk Creek near Drain. Discharge, in ft³/s, for indicated recurrence interval, in years and annual exceedance probability, in percent.

1.25	2	5	10	25	50	100
80%	50%	20%	10%	4%	2%	1%
3,580	6,110	10,500	14,000	19,100	--	--

Streamflow in the BHY WAU is assumed to be similar to the Elk Creek gaging station. We should expect most of the streamflow to occur from November through May with the maximum in January. We should expect to find no flow out of the watersheds for short periods of time in occasional dry years.

A method by Harris et. al (1979) was used to estimate the magnitude and frequency of floods for the compartments of the BHY WAU; results are presented in Table 3. The method requires area of lakes and ponds, drainage area, and precipitation intensity. The area of lakes and ponds was found to be less than 0.5% of the total area of the BHY; therefore, it had little significant effect on the estimated flows and was not used in the calculations. Precipitation intensity (I) is defined as the maximum 24-hour rainfall having a recurrence interval of 2 years. These values were determined from a map prepared by U.S. National Oceanic and Atmospheric Administration (1973). Estimates for I ranged from 4 inches at the lower elevations to 5 inches at the higher elevations.

The data in Table II.3 will be useful for future management purposes and in the design of river crossings (culverts and bridges) for the area. A single channel draining a specific area is necessary in order to apply this method; therefore, it can not be used on Elk Overpass, Devore Mountain, and Halo creek. Area of the downstream compartments was increased to include the flow contributed from upstream compartments. Area was reduced in Cowan and

Numbers in Table II.2
corrected from previous
version
6-3-96 chuplet

Table II.3. Magnitude and probability of instantaneous peak flow. Discharge in ft³/s for indicated recurrence interval, in years and annual exceedance probability, in percent.

Compartment	Area, (sqmi)	I, (in.)	2 50%	5 20%	10 10%	25 4%	50 2%	100 1%
Lower Thistle	21.00 ¹	4.25	1,750	2,770	3,400	4,320	5,070	5,710
Thistleburn Ck	4.69	4.0	450	690	850	1,060	1,230	1,390
Squaw Brush	10.44 ¹	4.5	1,030	1,600	1,960	2,470	2,880	3,240
Blue Brush	6.55	5.0	780	1,200	1,470	1,840	2,130	2,390
Lower Brush	14.36 ¹	4.5	1,350	2,120	2,600	3,290	3,840	4,320
Bear Lake	4.50	4.0	430	670	820	1,030	1,190	1,340
Bear Creek	6.73 ¹	4.0	610	950	1,160	1,470	1,700	1,920
Billy Creek	25.67 ¹	4.0	1,940	3,080	3,790	4,830	5,690	6,410
Flagler Canyon	4.61	4.5	510	780	950	1,200	1,380	1,550
Andrews Creek	5.94	5.0	710	1,100	1,350	1,690	1,950	2,190
Huntington Ck. ²	4.30 ¹	4.5	480	730	900	1,120	1,300	1,460
Cowan Creek	3.00 ¹	4.0	310	470	570	710	820	930
Rice Hill	8.95	4.0	780	1,220	1,500	1,890	2,200	2,480
Yoncalla WAU	29.59	4.0	2,190	3,490	4,290	5,480	6,460	7,290
¹ Area not the same as Table II.1.								
² Huntington compartments to exclude the flow from the Yoncalla Creek frontal.								

Yoncalla has more urbanization in it's watershed than do Brush Creek or Hayhurst Valley; therefore, it has a high proportion of its land impervious to water from pavement, roofs, and compacted lawns, etc., which will cause rapid runoff. The peak flow will be higher on this watershed than on the more undisturbed watersheds, and the time of runoff will be shorter even though the total amount of runoff may be greater.

Rosgen (1993) suggests the importance of assessing the magnitude of the mean annual flood

because most of the work of stream erosion (over time) is done by flows of moderate magnitude with recurrence intervals of one to two years. This is significant where excessive amounts of fine sediment are in transport through some stream systems. Elevated peak flows in some of the smaller drainages may also hinder natural adjustment and recovery processes within the streams by preventing aggradation and sorting of bedload, and by hindering revegetation and stabilization of streambanks.

The movement of water through the watershed is greatly influenced by the vegetation cover. Early seral stage stands are subject to earlier, faster runoff as precipitation occurs resulting in direct surface runoff. Older seral stage stands are likely to have reduced overland flows. This is attributable to a higher water storage capacity within these stands. Water absorbcency is enhanced with greater vegetation cover.

Summer low flows in the lower reaches of Billy and Yoncalla Creeks may be affected by human water withdrawals. Domestic water withdrawal, irrigation, agriculture, and livestock watering have all contributed to the lower volumes of water being present in the stream channels during the summer months. The volumes withdrawn and the consequences are not known, but water removal during summer can potentially decrease available habitat for aquatic life and increase summer water temperatures and pH simply because less water is in the channel. The harvest of riparian coniferous trees out of Brush Creek and Hayhurst Valley has allowed the development of hardwoods. Hardwoods use more water than conifers with a net result of less water in the stream (Hicks et al., 1991).

Peak flows occurring in the BHY WAU should not be effected by the transitional snow zone (elevations between 2,000 and 5,000 ft). About 2% of the Brush Creek watershed and less than 1% of Hayhurst watershed is above 2,000 ft.

Changes to the summer low-flow can occur for a variety of reasons. The removal of large wood from a channel can cause the release of accumulated sand, gravel, and cobble from the upstream sides of these wood jams, as the stream cuts its way down. In a natural, healthy

channel, these gravel storage areas act as large sponges, holding cool ground water and releasing it slowly. In the impacted channels, the gravel deposits are gone, intra-gravel flow is greatly diminished and overall water temperatures can increase. Roads can intercept surface and subsurface water, causing much of this water to run off of the landscape instead of recharging groundwater reserves. Changes in vegetation structure can cause more groundwater to be transpired by the new vegetation and less water available to contribute to summer stream flows.

Changes to the natural streamflow regime can be broken down into two major categories; increases in peak flows and decreases in summer low-flows. Specific areas of concern include high summer water temperatures, high pH, high turbidities during winter months, extremely low flows during summer months, and flow regimes which have been artificially altered. Higher peak flows can result in greater streambank erosion, greater sediment and larger woody debris transport, increased flooding, and degradation of fish habitat. Removal of forest canopy, ground compaction caused by tractor harvest and road construction, interception of ground water at road cut-slopes, and extension of channel network as a result of road ditchlines and relief culverts, have all been shown to increase peak flows.

II.3.3 Stream channel -- Geomorphology

Watersheds are sculptured by water, wind, and ice and evolve over time through erosion processes. Geomorphology is one of the sciences that aids in understanding this phenomenon and is fundamental to the study of watershed hydrology (Black, 1991). A number of geomorphic parameters can be obtained from maps or through GIS. These characterize watersheds by quantitatively describing them and can provide information used in making management decisions.

Area for the BHY WAU is given in Table II.1. It can be used to estimate total annual yield and flood potential. Area does not have an effect on average annual flow unless the watershed is influenced by ground-water storage and evapotranspiration. The minimum flow of a larger watershed will be more sustained than that of a small watershed because of large ground-

water storage. Streams on very small watersheds may dry up entirely during dry periods. If the same amount of rainfall is uniformly applied over two watersheds of different size, peak flows will be greater on larger watersheds when measured in absolute flow units (ft^3/s). However, when measured in units per unit area (csm) peak flows are lower and later on larger watersheds. Small watersheds exhibit higher high flows and lower low flows. Small watersheds are more likely to receive precipitation and deliver it as runoff simultaneously, where as precipitation on large watersheds takes longer to reach the outlet from remote portions, thus not all of the watershed is contributing simultaneously to peak flow. According to Black (1991) maximum peak flows, decay time, total runoff time, and time of concentration increases as the size of the watershed increases. The largest watershed is Yoncalla, the smallest is Brush Creek.

Drainage density (Table II.1) is a calculation of the total length of all stream segments of all orders in miles divided by the effective drainage area in square miles (Horton, 1932). It may be thought of as a closeness of spacing of channels or the length of channels per unit area. Thus drainage density is one of several linear measures by which the scale of features of the topography can be compared. Since it is a ratio it is of primary importance in land form scale analysis. With land use, ground surface resistance is lowered thus for predicting morphological changes drainage density can be related to erosion potential. A high drainage density represents a very complex watershed that should respond relatively fast to rainfall, and soils can be expected to erode easily, slopes are steep and vegetation sparse (Chow, 1964). It should be noted that not all lengths of natural streams that flow during winter rain storms may have been mapped; therefore, drainage density may be higher than that shown in Table II.1.

Wemple (1994) developed a process and investigated the effective extension of stream networks resulting from road drainage. She estimated that roads in her study area extended the stream network 60% over winter base flow stream lengths and 40% over storm event stream lengths. With an increase in surface flow as a result of ditchlines in a watershed, the rain or melting snow gets into streams quicker. Road drainage is a major cause of increased winter peakflows in streams in our area. The majority of roads within the BHY WAU are

constructed with ditches and/or insloped road surfaces that are intended to control water flow from the road surface. Once it is in the ditch, much of the water reaches the local stream channel faster than in an unroaded situation. In fact, some ditchlines effectively function as stream channel, so the actual length of flowing "streams" during rain storms is extended in the form of road ditches. Stream and road lengths and densities for the compartments in the BHY WAU are shown in Table II.1. When the drainage density is increased by the construction of roads we can expect to see more runoff in the form of increased peak flows and greater increases in mean annual floods. The problem may be compounded when the ground is harvested by tractors which may result in compacted soils, further adding to surface runoff. Extensive networks of trails exist in the BHY WAU, especially on slopes less than 40 percent.

Slope is important because it is a prime factor in infiltration capacity. Combined with elevation, slope can be an important factor in orographic effects, and combined with aspect, slope is also important in insolation considerations that play a role in evapotranspiration and snowmelt. At higher elevations slopes are generally higher with lower infiltration rates and more rapid runoff. Soil depth (Appendix 1, Soil's Report, Map 9) tends to be less at higher elevations owing to shorter time for soil to form. The overall effect is that average annual runoff is greater from small, high-elevation, steep-sloped, thin-soiled watersheds. Aspect is important to insolation, south-facing slopes are drier than north-facing slopes which are cooler. South-facing slopes are likely to have lower average annual runoff than other portions of the watershed.

Table II.4. General orientation of the stream channels in the BHY WAU.		
Compartment	Main Channel	Tributaries
Elk Overpass	NW	N, W
Lower Thistle	NW	E, W
Thistleburn Ck.	NW, W	N, S
Squaw Brush	NW, W	N, S
Blue Brush	NW	E, W
Lower Brush	NW	E, W
Bear Lake	E	N, S
Bear Creek	NE	N, S
Billy Creek	N	E, W
Flagler Canyon	N	E, W
Andrews Creek	N, E	N, S, E, W
Huntington Ck.	NE	N, E
Devore Mnt.	N	S, E
Halo Creek	N	SW, W
Cowan Creek	W	N, S
Rice Hill	NE	E, W

Streams may be divided into sediment source areas, transport areas, and depositional areas based on the slopes or gradient of the stream channels. High gradient streams are source areas for debris torrents. Medium gradient streams are transport areas that do not change significantly with time. Sediment tends to pass through them rather than be deposited. In general, low gradient streams are the most likely to change due to deposition and erosion of sediments. These streams provide the best quality for fish habitat because they have meanders, under cut banks, deep pools, large amounts of downed logs, and gravel tend to accumulate in these reaches.

The stream order and lengths of stream in GIS for the BHY WAU are presented in Table II.5. The stream order system was found to have some errors associated with it. Not all first order streams are in GIS because stream length was too small or the channel could not be defined; therefore, the number and length of first order streams (Table II.5) must be higher. It is not possible to have more 2nd order streams than 1st order, such as in Brush Creek and Hayhurst. In addition, these watersheds are too small to be 6th order. If we only use the perennial streams shown on USGS 1:24,000 topographic maps, we find Brush Creek is a 3rd order watershed and Hayhurst and Yoncalla are 4th order watersheds. This order is probably too small; however, it is of interest to note that this method shows Brush Creek is a lower order than Hayhurst and Yoncalla. The BHY WAU watersheds are probably all 5th order watersheds. A limited site inventory was done in September, 1995. No 1st order streams were found to be flowing, as expected. One 2nd order stream was found to be flowing; however, most were not flowing. Some 3rd order streams were flowing, some were not. All 4th, 5th, and 6th order streams visited were flowing. Only about 20% of the streams were visited for these analyses.

Table II.5. Number and length of streams by stream order for BHY.						
Stream Order	Brush Creek		Hayhurst		Yoncalla	
	Number	Length, (mi.)	Number	Length, (mi.)	Number	Length, (mi.)
1 st	130	42.45	189	51.69	201	61.52
2 nd	186	57.48	191	60.25	170	57.92
3 th	46	19.28	42	19.74	44	26.31
4 th	10	8.08	11	10.82	11	10.36
5 th	3	5.94	3	5.89	2	5.50
6 th	1	6.58	1	6.00	1	4.50
7 th	1	6.27	--	0.01	--	0.01
Lakes - Ponds	19	43.0	21	29.8	79	109.8
Total	377	146.08	437	154.40	429	166.12

The bifurcation ratio (R_b) is a way of expressing the amount of streams of a given stream order (Horton, 1945). The higher the ratio the larger the potential peak flow thus the more potential there is for erosion and nutrient and sediment transportation. Normal ranges are from 3.0 to 5.0, the theoretical minimum of 2.0 is rarely encountered. High bifurcation ratios are found in steep regions with narrow valleys. The data shown in Table II.4 can not be used to determine R_b because 1st order stream number must be greater than 2nd order stream number. If we assign two first order streams to all 2nd order streams and then calculate R_b , we find it is about 3.5 for each BHY watershed. This is probably in error because we should expect differences in R_b for these watersheds. Using the perennial streams identified on the USGS 1:24,000 topographic maps we calculate R_b at 3.7 for Brush Creek, 2.7 for Hayhurst, and 3.0 for Yoncalla. These values seem more reasonable for comparison purposes. Brush creek is longer and thinner, runoff should take longer to reach the mouth of the watershed and peak flows should be lower under the same moisture conditions.

Stream morphology is influenced by eight factors which change over time. They are: channel width, channel depth, water velocity, discharge (amount of water), slope of the stream channel, roughness of the stream bed, amount of sediment, and size of sediment (Leopold et al., 1964). In addition, stream bank vegetation influences stream bank stability. All of these factors interact. Change one and all of the other factors adjust.

II.3.4 Water quality

The State of Oregon's water quality standard for temperature is being revised upward, currently in streams with salmonids water temperatures must be maintained at or below 58 °F. In non-salmonid streams, no increase above 64 °F is allowed. Stream temperatures are being monitored on Brush Creek by the Oregon Department of Forestry. Stream temperatures were not monitored in the other two watersheds. In all three watersheds if the data were available we would expect to see peak temperatures in July and the maximum temperature to decrease with distance from Elk Creek.

Robison et. al (1995) installed 22 water and two air thermographs in the Brush Creek watershed (Figure 3 of their report--see Appendix 1, Fisheries Report). They determined the summer of 1994 to be warmer and drier than average, with low stream flows and sustained high air temperatures. The summary of their results is presented in Table 3 and Figure 6 of their report (see Appendix 1, Fisheries Report). They found water temperature versus distance from a divide to be a curvilinear relation. Two points that deviate from this were immediately downstream of a clearcut and within a beaver pond. Two of their observations were: clearcutting small non-salmonid streams in Coastal and Interior georegions in sandstone geology does not generally result in unacceptable temperature increases and when interpreting limited temperature data from the outlet of basins, care should be taken in making claims about cause and effects, especially cumulative watershed effects.

The width and height of riparian vegetation on either side needed to provide effective shade varies depending on the width of the stream, the direction of flow (orientation to the sun), and

the steepness of the streambanks. Many studies have investigated the effects of riparian vegetation on stream temperatures in the forest of the Pacific Northwest. Holaday (1992) found a trend of decreasing temperature with recovering riparian vegetation which had been removed by flooding, debris flows, or timber harvest. Stream channel characteristics can effect stream temperatures. Streams with narrow channels tend to have cooler stream temperatures. A stream with a gentle gradient is typically wide with shallow flow and slow velocity all of which contribute to stream heating. The diurnal fluctuation in temperature from day to night is important to aquatic organisms and overall water quality. Stress in fish and other organisms is reduced during night time recovery of cooler water. The loss of riparian shade increases the diurnal (day to night) water temperature fluctuation. In a managed basin such as Steamboat Creek, a tributary of the North Umpqua River, diurnal fluctuation has averaged from 7 to 11 °F, while in the unmanaged Boulder Creek wilderness, it has averaged 4 °F (Holaday, 1992).

The pH standard for aquatic life in the Umpqua Basin is 6.5 to 8.5, set by the Oregon Department of Environmental Quality. Levels above or below have adverse effects on some life cycle stages of certain fish and aquatic macroinvertebrates. River water in areas not influenced by pollution where photosynthesis by aquatic organisms takes up dissolved CO₂ during daylight and the organisms release CO₂ by respiration at night, pH fluctuation may occur and the maximum pH value may sometimes reach as high as 9.0 (Hem, 1985). Accumulations of stream algae can cause streams to become more alkaline. Photosynthesis during daylight hours consumes H ions and elevates pH. At night the pH decreases. On cloudy days or in shaded stream reaches not as much photosynthesis occurs and pH levels are lower.

Conditions that promote higher pH by increasing algae growth and accumulation are: 1) lack of riparian shade allowing the sun to stimulate algae growth; 2) the presence of bedrock streambeds which is ideal habitat for algae and poor habitat for algae-eating aquatic insects; and 3) a nutrient supply. Conditions that promote lower pH are: 1) effective riparian shade; 2) streambeds with large wood and associated gravel/cobble substrate where algae-eating insects thrive; 3) up slope forest stands that use (cycle) nitrogen and store it in the soil and

vegetation, so nitrogen is not as available to runoff into streams. Nutrient runoff into streams from harvested areas plays a primary role in increased algae and pH levels.

The equilibrium concentration of dissolved oxygen (DO) in water in contact with air is a function of temperature and pressure. The higher forms of aquatic life require oxygen for survival. According to Hem (1985) the DO concentration may be depleted by processes that consume dissolved, suspended, or precipitated organic matter, and values above equilibrium can be produced in systems containing actively photosynthesizing biota.

The Oregon Department of Environmental Quality (DEQ) routinely monitors 3,500 mi of streams. According to the Department of Environmental Quality (1988) Billy Creek was "observed" to have a moderate problem with turbidity, nutrients, erosion, and stream structure. Elk Creek was "observed" to have a moderate problem in turbidity, sediment, and erosion. "Samples" for Elk Creek were found to have a severe problem in bacteria or virus and a moderate problem in low DO and flow. Dates and frequencies for these data are not available so it is not known what time of the year the problem occurred or how often. The problems associated with Elk Creek probably are not related to the BHY WAU, but they should be considered indications of possible future water quality conditions. For the current study, a water quality sample was collected to identify select chemical constituents for base line information on the general water quality at the mouth of each watershed upstream of Elk Creek. The data are in Table 5, none were found to exceeding EPA drinking water standards. They generally show the baseflow for the BHY WAU is of very good quality for the sampled constituents. Water temperature for all three sites was found to exceed the current DEQ limit.

Table II.6. Water quality data collected for selected sites, September 21, 1995.

Site	Water Temp. (°F)	Specific Cond. (uS/cm)	DO (mg/l)	N-NO ₂ (mg/l)	N-NO ₃ (mg/l)	Cl (mg/l)	Br (mg/l)	P-PO ₄ (mg/l)	SO ₄ (mg/l)	streamflow (ft ³ /s)
Brush Ck	61.0	100	11.0	<0.01	<0.01	9.8	<0.2	0.2	3.6	0.24
Billy Ck	63.5	330	10.0	0.01	0.02	84.0	<0.2	<0.2	0.7	0.33
Yoncalla Ck	61.0	265	8.0	<0.01	<0.01	42.0	0.5	<0.2	1.0	0.05

Streams carry suspended particles or sediment. Particle size depends on the amount of flow. According to Hem (1985) a generalized terminology call sediment having particle diameters ranging from 0.24 to 4 μm "clay", 4 to 62 μm "silt", and 62 μm to 2.0 mm "sand". In general, suspended sediment may be considered a pollutant when it exceeds natural concentrations by increasing the turbidity to a point that it affects the biotic balance. Roads also have the potential to affect the sediment regime.

Turbidity reduces the depth to which sunlight penetrates and thus alters the rate of photosynthesis and can impair the capture of food by fish. Turbidity is an expression of the optical property of water that scatters light (Dunne and Leopold, 1978). The scattering increases with suspended particulate matter, which may be organic or inorganic. Values of turbidity are often expressed in Jackson Turbidity Units. Turbidity increases with, but not as fast as, suspend-sediment concentrations.

Robison and Collins (1977) describe the ground water in the Drain-Yoncalla area as diverse in chemical character. There is no definite pattern in chemical character. There is no definite pattern of distribution of the types of water but waters with a high concentration of dissolved solids are more likely to be found near the contacts of the basalt members and the sandstone and siltstone member of the Umpqua Formation. The Tyee Formation is not characterized by a single type of water, except that high concentrations of dissolved solids are not common. The average water temperature reported by drillers was 54 °F almost the same as the mean

annual air temperature at Drain (53 °F).

Geology shapes the drainage patterns, determines the type of sediment available to the streams, and influences water chemistry. Soils are a product of weathered bedrock. The type of soils present influence water infiltration rates, erosion potential, and vegetation. Vegetation affects channel stability and upslope erosion rates. Vegetation can also affect stream morphology by providing root strength to stabilize stream banks and by providing organic debris to the streams. Organic debris includes leaf litter, which is an important component of the food chain, and large woody debris, which form pools and capture gravel. All these factors should be considered if we intend to maintain and improve the water quality of the BHY WAU. The water quality data available and collected for this analysis were limited.

III. FISH

III.1 Introduction

The Bureau of Land Management (BLM) administers approximately 13,000 miles of spawning and rearing streams for anadromous (and resident) salmonids in five States: Alaska, California, Idaho, Oregon and Washington. As stated in various Bureau documents, the BLM has made it a priority to work towards the protection, restoration and enhancement of anadromous and native fish stocks and to restore and maintain their associated watersheds and aquatic ecosystems (Option 9/ROD; BLM Fish and Wildlife 2000: A Plan for the Future; BLM Roseburg District ROD/RMP; Federal Guide for Watershed Analysis).

Table III.1. Anadromous fish habitat on Bureau lands.		
State	Habitat (mi.)	Major Species
Alaska	10,000 ¹	Chinook, sockeye, chum and pink salmon, steelhead trout, char, cisco, whitefish
California	190	Chinook, coho, steelhead
Idaho	1,300	Chinook, sockeye, steelhead
Oregon	1,432	Coho, chinook, chum, steelhead, sea-run cutthroat trout
Washington	51	Steelhead, chinook
Total	12,973	
¹ Actual inventory data for Alaska streams is not available. Estimate of stream miles derived from a variety of sources.		

III.2 Historical Conditions

Fish have been an extremely important ecological, commercial and recreational consideration in the State of Oregon and the Umpqua River Basin. Salmon remain a critical component of subsistence fisheries and the cultural heritage of Native American. Since the settlement of

the State and the basin by Europeans, anadromous salmonids, especially Coho salmon (Oncorhynchus kisutch), have been the mainstay of the commercial and recreational salmon fishery of the Oregon Coast.

III.2.1 Coho Salmon

Coho salmon occur naturally only in the Pacific Ocean and its tributary drainage. Its range in fresh water in North America is from Monterey Bay, California (in the sea infrequently to Baja California) to Point Hope, Alaska. In Asia, coho occur from the Anadyr River, Russia to Hokkaido, Japan (Scott and Crossman 1973).

One hundred years ago, runs of wild Coho in coastal Oregon streams were estimated at 1,400,000 fish per year. In the 1970s, the Coho troll fishery provided from \$60 to \$70 million per year in direct personal income for Oregon coastal communities. By 1988, the salmon harvest (including Chinook) generated \$43 million for the Oregon coast economy. In 1993, salmon harvest (Coho fishery now closed) generated only \$3.5 million - an 85% reduction of economic benefits in six years. The average number of spawners in 1991-1993 was estimated at 38,000 fish, about 3% of the historical level stated above (Oregon Sea Grant, January 1995).

It is estimated that wild Coho populations in the Umpqua basin account for 25-30% of the total number of wild Coho along the Oregon coast (Loomis, personal communication, as cited in the Jackson Creek Watershed Analysis). Umpqua Coho contribute primarily to Oregon ocean fisheries, with a minor contribution to northern California and southern Washington ocean harvest.

Wild Coho salmon in the Umpqua basin were assessed at a moderate risk of extinction due to widespread habitat degradation and influences from hatchery-reared fish (Nehlsen et. al., 1991). In July 1995, the Umpqua Coho and four other stocks in Oregon, were officially proposed as Endangered by the NMFS.

III.2.2 Sea-run Cutthroat Trout

The cutthroat trout (O. clarki) occurs in fresh, brackish or salt water in North America mostly west of the Rocky Mountains. Its distribution closely corresponds with the Pacific Northwest and Alaska coniferous rain forests, extending on the coast from the Eel River in northern California to Prince William Sound, southeastern Alaska. Cutthroat trout are also found as far inland as central Colorado and northwestern New Mexico (Scott and Crossman 1973).

Sea-Run Cutthroat Trout have also been an important fishery in Oregon since the mid-1930s. Run sizes varied greatly between river basins, with the Suislaw River having the largest - approximately 31,000 fish. In the North Umpqua River, the average run size was 700 spawners between 1946 and 1960 (Schneider, personal communication). In a report prepared in 1972 by the Oregon State Game Commission (OSGC), it was estimated that 2,000 sea-run CTT spawned in the North Umpqua system.

Recently, the run size in the North Umpqua has declined precipitously. The average run size between 1986-87 and 1994-95 was 28 fish at the Winchester dam, with no fish counted in 1992-93 and only one in 1994-95 (ODFW, 1995). Sea-Run Cutthroat Trout were proposed as Endangered by NMFS on July 8, 1994 in the Umpqua River Basin, with all life forms included in the proposed listing.

NOTE: For more details on Coho salmon and Cutthroat trout distribution and life histories see Appendix 1, Fisheries.

III.3 Desired Future Condition

To maintain and/or restore properly functioning aquatic ecosystems for anadromous and resident salmonids and other native fish species.

III.4 Key Questions

The Key Questions to be answered in this watershed analysis regarding fish are:

- What species occur and what is their distribution in the analysis area?
- What are the current habitat conditions and what are the identifiable limiting factors to fish production and distribution?
- Where is good quality fish habitat?
- What management actions (and inactions) are needed to maintain and improve good, and improve and restore degraded, habitats?

III.5 Fish Occurrence and Distribution

Key Question: What species occur and what is their distribution in the analysis area?

The Umpqua River Basin is home to eight native anadromous species of fish, including the proposed endangered Sea-run Cutthroat Trout and Coho Salmon; more than ten native resident species; and at least eighteen non-resident/exotic/introduced species (See Table III.2).

Historically, the entire Umpqua River basin stream network either supported, or had the potential to support, anadromous salmonid production. For purposes of this watershed analysis, fish distribution is noted to the most upstream point within each stream, with the assumption that anadromous salmonids are also likely to be found to at least this point, in the

absence of passage problems and water quality limitations (see Figure III.1).

Table III.2. List of fish in the Umpqua River basin.

TYPE	COMMON NAME	SCIENTIFIC NAME
NATIVE ANADROMOUS	Sea-run Cutthroat trout Coho salmon Summer/Winter Steelhead trout Spring/Fall Chinook salmon Green Sturgeon White Sturgeon Pacific lamprey	<i>Oncorhynchus clarki</i> <i>Oncorhynchus kisutch</i> <i>Oncorhynchus mykiss</i> <i>Oncorhynchus tshawytscha</i> <i>Acipenser medirostris</i> <i>Acipenser transmontanus</i> <i>Lampetra tridentata</i>
NATIVE RESIDENT	Cutthroat trout Rainbow trout Oregon (Umpqua) chub Umpqua dace Longnose dace Umpqua squawfish Largescale sucker Redside shiner Speckled dace Brook lamprey Sculpin species	<i>Oncorhynchus clarki</i> <i>Oncorhynchus mykiss</i> <i>Oregonichthys kalawatseti</i> <i>Rhinichthys evermanni</i> <i>Rhinichthys cataractae</i> <i>Ptychocheilus umpquae</i> <i>Catostomus macrocheilus</i> <i>Richardsonius balteatus</i> <i>Rhinichthys osculus</i> <i>Lampetra richardsoni</i> <i>Cottus spp.</i>
NON-NATIVE	Brown trout Brook trout Lake trout Kokanee Largemouth bass Smallmouth bass Sunfishes Yellow perch White Crappie Black Crappie Black Bullhead Brown Bullhead Yellow Bullhead Peamouth Striped Bass Shad Mosquito fish Threespine stickleback Olympic mudminnow	<i>Salmo trutta</i> <i>Salvelinus fontinalis</i> <i>Salvelinus namaycush</i> <i>Oncorhynchus nerka</i> <i>Micropterus salmoides</i> <i>Micropterus dolomieu</i> <i>Lepomis spp.</i> <i>Perca flavescens</i> <i>Pomoxis annularis</i> <i>Pomoxis nigromaculatus</i> <i>Ameiurus melas</i> <i>Ameiurus nebulosus</i> <i>Ameiurus natalis</i> <i>Mylocheilus caurinus</i> <i>Morone saxatilis</i> <i>Alosa sapidissima</i> <i>Gambusia affinis</i> <i>Gasterosteus aculeatus</i> <i>Novumbra hubbsi</i>

Sources: BLM Roseburg District PRMP/EIS, Vol. II;
Dave Harris, personal communication, ODFW-Roseburg

III.5.1 Brush Creek Subbasin

Brush Creek: Fish were noted to 16.14 km upstream from the confluence with Elk Creek in both the mainstem, with headwaters on the north side of Yellow Butte, T23S-R6W, Section 21; and the last major tributary with headwaters on the north side of Broken Back Ridge, T23S-R6W, at the junction of Sections 16, 17, 20 and 21. CTT were also found in an unmarked, unnamed tributary in T22S-R6W, Section 8, with its headwaters on the north side of Blue Buck Mountain in Section 17. Spawning surveys since 1988 indicate that Brush Creek is an extremely important Coho salmon production stream.

Thistleburn Creek: Fish were noted to 4.14 km upstream from the confluence with Brush Creek, T22S-R6W, Section 33. Fish were also found in several of the unnamed tributaries with headwaters near Deadman Butte, T22S-R6W, Sections 29 and 30.

Squaw Creek: Fish were noted to 2.28 km upstream from the confluence with Brush Creek, T23S-R6W, Section 5.

Blue Hole Creek: Fish were noted up 1.16 km upstream from the confluence with Brush Creek, T23S-R6W, near where Sections 8 and 17 meet.

III.5.2 Hayhurst Valley Subbasin

Billy Creek: In Middle Canyon Creek, tributary to the South Fork, fish were noted to 1.4 km upstream from the confluence with Five Point Canyon Creek, T23S-R6W, Section 13. In Five Point Canyon Creek, tributary to the South Fork, fish were noted to 1.2 km upstream from the confluence with Middle Canyon Creek, T23S-R6W, Section 13. No fish were noted in the East Fork, which drains the southwest side of Devore Mountain, T23S-R5W, mainly in Section 6.

Flagler Canyon: Fish were noted to 2.7 km upstream from the confluence with the South Fork of Billy Creek, T23S-R5W, Section 18.

Bear Creek - downstream from Bear Lake: Fish were noted in Bear Creek downstream from Bear Lake to Billy Creek, T22S-R6W, Sections 24, 25 and 26.

Bear Lake - Bear Creek upstream from Bear Lake: In Bear Creek, upstream from Bear Lake, fish were noted to 1.0 km upstream from the confluence with the last, unnamed tributary to the north, at the intersection of Section 34, T22S-R6W and Section 3, T23S-R6W. In Lost Cabin Creek, fish were noted to 1.5 km upstream from the confluence with its unnamed north tributary, near the intersection of Sections 27 and 28, T22S-R6W. In the unnamed north tributary, fish were noted to 1.9 km upstream from the confluence with Lost Cabin Creek, at the intersection of Sections 22 and 27, T22S-R6W.

Andrews Creek: Recent ODFW and ODF surveys noted fish in Andrews Creek to 2.4 km upstream from the confluence with Snail Canyon Creek, T23S-R6W, Section 15.

The main tributaries of Andrews Creek are Green Ridge Creek (lower reach on BLM land T23S-R6W, Section 3), Snail Canyon Creek (mainly on BLM land in T23S-R6W, Sections 11 and 15) and an unnamed creek above Snail Canyon flowing west to east (upper reach on BLM land T23S-R6W, Section 9). In Green Ridge Creek, fish were noted to 2.3 km upstream from the confluence with Andrews Creek. In Snail Canyon, fish were noted to 1.6

km upstream from the confluence with Andrews Creek, T23S-R6W, at the junction of Sections 11 and 14. In the unnamed creek, fish were noted to 0.9 km upstream from the confluence with Andrews Creek, T23S-R6W, at the junction of Sections 9 and 10.

III.5.3 Yoncalla Subbasin

Halo Creek: Fish were noted 2.1 km upstream from the confluence with Yoncalla Creek on private land, T23S-R5W, Section 2. Only a small headwaters area is on BLM land, T22S-R5W, Section 25. This upper reach is classified as salmon habitat by ODFW.

Devore Mountain: No fish were noted in the tributaries of Billy and Yoncalla Creeks that drain Devore Mountain to the west, south and northeast.

Huntington Creek: Fish were noted to 3.1 km upstream from the confluence with Yoncalla Creek, T23S-R5W, Section 16.

Cowan Creek: Fish were noted to 1.4 km upstream from the confluence with Yoncalla Creek, T23S-R5W, Section 11.

Wilson Creek: Fish were noted to 2.3 km upstream from the confluence with Yoncalla Creek, T23S-R5W, Section 23.

Yoncalla Creek: Fish were noted upstream from the confluence with Elk Creek to 0.2 km west of I-5 at the town of Rice Hill, T23S-R5W, Section 28.

III.6 Aquatic Habitat Conditions and Limiting Factors

Key Questions: What are the current aquatic habitat conditions?

Where is the good/properly functioning fish habitat?

What are the identifiable limiting factors to native fish production and distribution?

Anadromous salmonids are an important natural resource of the Umpqua River Basin. The streams in the BHY WAU have historically made significant contributions to salmonid and other native fish production. The BHY WAU, as with most subbasins on BLM Roseburg lands, has a long, continuous disturbance history, with the past thirty years particularly strong (See Weber's table). At present, the majority of the aquatic habitat conditions in the BHY WAU are quite degraded in comparison to natural, properly functioning conditions.

The equivalent clearcut area during the past twelve years ranges from ten to twenty percent per decade, average road density is over 6 miles/mile² (range of 2.82 to 8.77), with roads along almost all stream valley bottoms, and there are extensive areas of very recent (1994 and 1995) timber harvesting. All these activities have negatively impacted the aquatic ecosystem through increased water temperatures, stream width-to-depth ratios and sedimentation rates; changes in base and peak flows; and loss of channel complexity, large woody debris attainment and recruitment, side channels and connectivity with the floodplain (except in very high rainfall events).

Data from the ODFW Aquatic Habitat Inventories of 1993 and 1994 were analyzed to determine an overall aquatic habitat rating (AHR) of Excellent, Good, Fair or Poor for each stream, as well as the AHR for individual reaches (see Appendix 1, Fisheries Report).

Reaches were identified in each stream based on channel and valley morphology, gradient, instream substrate and land use. The ratings were then correlated to the NMFS Matrix (see Appendix 1, Fisheries Report), in order to make a determination as to whether the aquatic habitat was properly functioning, at risk or not properly functioning, as shown below in Table III.3.

Table III.3. Aquatic Habitat Ratings	
ODFW Aquatic Habitat Inventories	NMFS Matrix
Excellent or Good	Properly Functioning
Fair	At Risk
Poor	Not Properly Functioning

In the BHY WAU, ODFW Aquatic Habitat Inventories have been completed, and AHRs determined, for the mainstems of Brush, Thistleburn, Squaw and Blue Hole Creeks (Table III.4). Streams located within the BHY WAU which have not been inventoried, or inventoried, but the data not yet available for analysis, are: Billy, Bear, Andrews, Flagler Canyon, Yoncalla, Huntington, Halo, Wilson and Cowan Creeks.

Table III.4. Aquatic Habitat Ratings for Streams in the Brush Creek Subbasin

STREAM NAME Survey Dates	Reach No.	Pool Area %	Residual Pool Depth (m)	Wetted W/D Ratio	Riffle Fines %	Riffle Gravel s %	Dominant Substrate %
BRUSH 12-18 Aug 93	1	64	0.37	56	8	38	Cobble 28
	2	42	0.29	29	5	10	Bedrock 62
	3	49	0.35	41	7	27	Bedrock 48
	4	88	0.6	22.6	11	63	Gravel 50
	5	39	0.29	32	7	13	Gravel 44
	6	21	0.32	22	9	34	Boulder 32
	7	15	0.27	11.5	12	48	Gravel 36
THISTLE- BURN 14-16 Sep 1993	1	39	0.3	36	15	32	Bedrock 28
	2	46	0.3	23	14	61	Gravel 33
	3	45	0.35	19	36	39	Gravel 34
	4	0	-	-	20	17	Cobble 38
SQUAW 06-07 Jul 1994	1	79	0.3	25	13	81	Gravel 60
	2	63	0.32	36	22	63	Gravel 37
	3	0	-	-	-	-	Silt/Org 33
BLUE HOLE 23 Aug - 01 Sep 1993	1	21	0.11	-	-	-	Gravel 40
	2	10	0.11	-	-	-	Gravel 40
Conditions Key	excell good fair poor	> 44 30-44 16-29 < 16	> 0.59 0.41-0.59 0.21-0.40 < 0.21	< 11 11-20 21-29 > 29	< 2 2-7 8-14 > 14	> 79 30-79 16-29 < 16	Gravel/Cobble Cobble/LgBldr Cobble/SmBldr Bedrock/anythg

III.6.1 Brush Creek Subbasin

The Brush Creek subbasin is 70% private ownership and 30% federal ownership. The main land use activity is timber harvesting. There are 146.08 miles of streams with a stream density of 6.19 miles/mile². The road density is 4.94 miles/mile², with roads along almost all stream valley bottoms. The majority of streams are At Risk or Not Properly Functioning.

Brush Creek: The overall AHR for the mainstem of Brush Creek is Fair/At Risk. There are seven reaches delineated within this stream; four which rate as Fair/At Risk, and three which rate as Good/Properly Functioning. Note: the ODFW habitat inventory was conducted before a private clearcut was harvested to the streambank (one tree buffer) along reach 3, thus the overall AHR may actually be lower. Instream structures have been placed in reach 3 by ODFW, to mitigate some of the negative impacts of the clearcut mentioned above. There are 37.36 stream miles, with a stream density of 6.36 miles/mile² (Lower Thistle and Lower Brush combined). Road density is approximately 4.0 miles/mile², with a highly-utilized road along the entire stream valley bottom, BLM 22-7-14.1.

Ownership is mainly private. Parts of Brush Creek run through BLM land in T22S-R7W, Sections 13 and 25; and T23S-R6W, Sections 8, 15, 20 (PD) and 21. Land use in the adjacent areas to the stream is second growth and young timber, except reach 1, which has some agricultural use; and reaches 3 and 7, which have undergone recent clearcut timber harvests (see note above). A commercial thinning is currently (October 1995) taking place along reach 5.

Limiting factors include LWD attainment and recruitment, shallow residual pool depths, high percentage of bedrock substrate and low percentage of gravel in riffles.

Thistleburn Creek: The overall AHR for the mainstem of Thistleburn Creek is Good/Properly Functioning. Four reaches were delineated, with two rated Fair and two rated Good. Note: the ODFW habitat inventory was made before a private clearcut was

harvested to the streambank (one tree buffer) along reach 1. Thistleburn Creek appears to function as a source of cooler water for Brush Creek. There are 27.56 stream miles, with a stream density of 5.87 miles/mile². Road density is approximately 5.21 miles/mile², with a highly-utilized road along the entire stream valley bottom, BLM 22-7-24.0.

Ownership: The majority of land is BLM in T22S-R6W, Sections 19, 29 and 33. Land use for the stream is second growth and young timber, except in reach 1, which has undergone recent timber harvest (see note above). Instream structures are planned for reach 1 in summer 1996, to mitigate for some of the negative impacts of the clearcut mentioned above.

Limiting factors include LWD attainment and recruitment, shallow residual pool depths and a high percentage of fine sediments (silt, sand and organics) in riffles.

Squaw Creek: The overall AHR for the mainstem of Squaw Creek is Fair/At Risk. Three reaches have been delineated, with one each rated as Poor, Fair and Good. There are 21.91 stream miles, with a stream density of 5.63 miles/mile². Road density is approximately 5.39 miles/mile². The valley bottom road, BLM 23-6-6.0, appears to be regularly utilized to 22-6-31.2 and infrequently utilized between 22-6-31.2 and 31.1. Above 31.1, the road appears to be rarely utilized, as it is rutted, overgrown with weeds and contains water ponds and associated sink holes in low-lying areas.

Ownership: Most of the Squaw Creek drainage is BLM land in designated LSR, T22S-R6W, Section 31 and T23S-R6W, Section 5. Approximately one-half mile of the stream valley bottom road is on private, T22S-R6W, Section 32 (\approx 2,000 feet) and T23S-R6W, Section 6 (\approx 600 feet).

Limiting factors include LWD attainment and recruitment, and shallow residual pool depths.

Blue Hole Creek: The overall AHR for the mainstem of Blue Hole Creek is Fair/At Risk.

The two individual reaches also rate as Fair. There are 40.81 stream miles, with a stream density of 6.23 miles/mile². Road density is approximately 5.16 miles/mile², with a highly-utilized road, BLM 23-6-6.2, along the entire stream valley bottom. The road has ruts and evidence of water runoff starting a few hundred feet below the junction with road 23-6-18.1 and continuing up 18.1.

Ownership: More than half of the drainage is owned by private landowner(s). BLM has small holdings in T23S-R6W, Sections 7 and 17 and the headwaters area in Section 19.

Limiting factors include a low percentage of pool area, shallow residual pool depths and LWD attainment and recruitment.

III.6.2 Hayhurst Valley Subbasin

The Hayhurst Valley subbasin is 74% private ownership and 26% federal ownership. Main activities are timber harvesting. There are 154.4 miles of streams with a stream density of 6.01 miles/mile². Road density is 6.20 miles/mile², with roads along almost all stream valley bottoms. Through direct observation and inspection of the larger streams in the subbasin, it appears that the majority of streams are At Risk or Not Properly Functioning.

Billy Creek: The overall AHR is unknown, as ODFW Aquatic Habitat Inventory data are incomplete or unavailable for this stream. There are 46.5 miles of streams with a stream density of 5.54 miles/mile². Road density is 6.53 miles/mile² with highly-utilized roads along the stream valley bottoms; County Highways 24 and 71 along the mainstem and BLM roads 23-6-12.0 along the South Fork, 12.1 along Five Point Canyon and 12.2 and 13.1 along Middle Canyon and its unnamed tributary.

Ownership: The vast majority is private. Land uses are residential, cattle grazing and timber production and harvesting.

Flagler Canyon: The overall AHR is unknown, as ODFW Aquatic Habitat Inventory data

are incomplete or unavailable for this stream. There are 31.15 miles of streams with a stream density of 5.76 miles/mile². Road density is 6.63 miles/mile², with a highly-utilized road along the entire stream valley bottom; County Road 71A.

Ownership: All private, except small headwaters area on BLM land, T23S-R5W, Section 19. Land uses are residential, cattle grazing and timber production and harvesting.

Bear Creek - downstream from Bear Lake: The overall AHR for Bear Creek downstream from Bear Lake is unknown, as Aquatic Habitat Inventory data are incomplete or unavailable. There are 12.62 miles of streams with a stream density of 5.63 miles/mile². Road density is 6.73 miles/mile², with a highly-utilized road along the entire stream valley bottom, BLM 22-6-24.0 and 24.1.

Bear Lake - Bear Creek upstream from Bear Lake: The overall AHRs for Bear Creek upstream from Bear Lake and Lost Cabin Creek are unknown, as Aquatic Habitat Inventory data are incomplete or unavailable for these streams. There are 27.91 miles of streams with a stream density of 6.20 miles/mile². Road density is 5.69 miles/mile², with highly-utilized roads along the stream valley bottoms; BLM 22-6-24.1 along Bear Creek and 22-6-27.0 and 22-6-35.0 along Lost Cabin Creek.

Andrews Creek: The overall AHRs are unknown for Andrews Creek and its main tributaries, Green Ridge Creek, Snail Canyon Creek and an unnamed creek above Snail Canyon flowing west to east. Aquatic Habitat Inventory data are incomplete or unavailable for these streams. There are 36.22 miles of streams with a stream density of 6.10 miles/mile². Road density is 5.62 miles/mile², with highly-utilized roads along the stream valley bottoms; BLM 23-6-2.0 along Andrews Creek, 23-6-10.1 along Green Ridge Creek and 23-6-10.0 along Snail Canyon Creek.

Ownership: Mostly private. The upper reach/headwaters of Andrews Creek are on BLM land, T23S-R6W, Section 15. The lower reaches pass through residential and cattle grazing

areas. The lower reach of Green Ridge Creek is on BLM land, T23S-R6W, Section 3. Snail Canyon Creek is mainly on BLM land in T23S-R6W, Sections 11 and 15. The upper reach of the unnamed creek above Snail Canyon is on BLM land, T23S-R6W, Section 9. Land use: There is timber harvesting in progress (October 1995) in Sections 2 and 10 and recent clearcutting (Summer 1995) to stream (one tree buffer) by private landowner in Section 10.

Limiting factors: Fish passage is a major concern along Andrews Creek, as almost all culverts along 23-6-2.0 are either undersized, rusted out with water flowing underneath, the inlets and/or outlets are pinched or the pipe is misaligned (i.e. one inlet at 90° angle from stream flow). Also, there is a lack of shade and LWD attainment and recruitment, a high percentage of bedrock substrate, a low percentage of pool area and shallow residual pool depths.

III.6.3 Yoncalla Subbasin

The Yoncalla subbasin is 94% private ownership and 6% federal ownership, which includes the town of Yoncalla and Interstate 5. Main activities are cattle grazing. There are 166.1 miles of streams, with a stream density of 5.61 miles/mile². Road density is 6.84 miles/mile², with roads along most stream valley bottoms. Through direct observation of the larger streams in the subbasin, it appears that the majority of streams are At Risk or Not Properly Functioning.

Halo Creek: The overall AHR is unknown for Halo Creek. There are 32.57 miles of streams, with a stream density of 6.09 miles/mile². Road density is 4.74 miles/mile².

Ownership: All private except small headwaters area on BLM land, T22S-R5W, Section 25. Land uses are residential, agricultural and cattle grazing.

Limiting factors: Ownership pattern.

Devore Mountain: The AHRs are unknown for the tributaries of Billy and Yoncalla Creeks that drain Devore Mountain. There are 43.95 miles of streams, with a stream density of 5.90 miles/mile². Road density is 7.17 miles/mile².

Huntington Creek: The overall AHR is unknown for Huntington Creek. There are 27.24 miles of streams, with a stream density of 6.09 miles/mile². Road density is 6.48 miles/mile², with a highly-utilized, paved road, County Highway 30, along most of the of the stream's length and an unimproved road, BLM 23-5-20.0, along one of the headwaters tributaries.

Cowan Creek: The overall AHR is unknown for Cowan Creek. There are 19.66 miles of streams, with a stream density of 5.83 miles/mile². Road density is 8.77 miles/mile².

Ownership is all private. Land uses are municipal, residential, agricultural and cattle

grazing.

Limiting factors: Ownership pattern

Wilson Creek: The overall AHR is unknown for Wilson Creek.

Ownership is all private. Land uses are municipal, residential, agricultural and cattle grazing.

Limiting factors: Ownership pattern

Yoncalla Creek: The overall AHR is unknown for Yoncalla Creek. There are highly-utilized, paved roads along the entire stream valley bottom; Interstate 5 and U.S. 99.

Ownership is all private. Land uses are municipal, residential, agricultural and cattle grazing.

Limiting factors: Ownership pattern

IV. VEGETATIVE CONDITION

Since 1945, 6046 acres of forests have been harvested on BLM managed lands within the BHY WAU. Yearly harvest levels averaged 118.5 acres (Figure IV.1).

IV.1 Desired Future Condition

Manage age class distribution:

- ▶ sufficient to achieve desired objectives for each LUA,
- ▶ to provide suitable habitat necessary to manage special status species (T&E, S&M, buffer species, and noxious weeds),
- ▶ to maintain/improve soil productivity, and
- ▶ to maintain/improve connectivity within and between watersheds.

IV.2 Key Questions

1. What is the current age class distribution within each LUA?
2. What are the management opportunities with each LUA?
3. Where are skid trail or road densities causing soil problems and what can be done to improve their conditions?
4. What is the current condition of connectivity within and between watersheds and what can be done to improve it?
5. What special status plant species are known to occur or have the potential to occur within the analysis area?

IV.3 What is the current age class distribution within each LUA?

For the BHY - WAU, the age class distribution on Federal lands was estimated by using GIS (ArcInfo). See Table IV.1.

Table IV.1. Age Class Distribution, Federal Lands, by LUA, BHY WAU.

Age-Class	GFMA		CON		LSR		Riparian Res.		TOTALS	
	Acres	%	Acres	%	Acres	%	Acres	%	Acres	%
Non-Forest	6	0	0	0	32	0	2	0	40	0
1-15	444	16	169	28	1148	17	523	16	2,284	17
16-45	1029	37	132	22	1459	22	1192	37	3,812	29
46-105	493	18	26	4	1103	16	572	18	2,194	16
106-195	351	13	131	22	1827	27	377	12	2,686	20
196+	443	16	150	25	1129	17	570	18	2,292	17
TOTALS	2,766		608		6,698		3,236		13,308	

Discussion

The current age class condition of the Federal lands is mainly a result of two processes: logging and fire. Currently, the dominant influence on the age class distribution has been logging. Harvesting in a large scale started in the 1950's and continued up to 1990. Some small scale salvage and post sales occurred in the 1940's. The younger age class forests (1 to 40 years) are predominantly a result of clearcut logging and the subsequent regeneration of the logged areas. The regenerated areas are mostly in a patchy arrangement across the landscape that result from the staggered-setting arrangement of harvest units. Based upon the MicroStorms database, 197 units have been harvested in the watershed. Average unit size is about 30 acres, with harvested areas typically ranging in size from 5 to 50 acres. Before logging, fire was the major factor influencing the forest. Stand replacement fires have resulted in large (>100 acres) even-aged stands. Small gaps occur in these stands as a result of small scale disturbances such as disease, fire, and wind that have killed trees singly or in groups.

IV.4 Where are skid trail or road densities causing soil problems and what can be done to improve their conditions?

Haul Roads and Skid Trails: Logging operations over the years have resulted in an extensive road system and a vast network of skid trails and primitive haul roads (Appendix 1, Soil's Report, maps 30-39). Road mileage and density figures are somewhat misleading (Table II.1). The GIS data base has included a limited number of primitive haul roads - skid trail groupings while ignoring the many others. Within these groupings only a limited number of the major trails are mapped. In some cases old groupings, barely discernible on the 1994 aerial photos are included while younger ones still driveable are not. A future data gap need might be to decide what kind of roads and trails should be in the GIS system and apply this decision consistently across the WAU to get meaningful road densities which can be interpreted.

Most of the roads which are currently part of the transportation network are rocked and most of these do not currently have major mass wasting (landslides) and erosion problems. Most of the unsurfaced dirt roads and nearly all of the old skid trails are currently inaccessible to vehicle traffic due to the overgrowth of vegetation, washouts or intentional blockage through gating and trunk traps. As a result, in the absence of vehicle traffic there has been a healing process which in many cases has essentially eliminated erosion problems. Severe ongoing erosion of these old, inaccessible roads and trails are likely small inclusions.

Some private landowners have recently waterbarred and blocked a number of their unsurfaced roads in the Brush Creek watershed. Stabilization of these roadbeds seem to be progressing satisfactorily. A couple of logging operation involving unsurfaced roads are currently underway in the Blue Brush and Squaw Brush subbasins. The mitigation to be applied is unknown.

Unsurfaced roads and skid trails are a major impact of the eight operations on private surface in Andrews Creek which just completed or are close to completion. The access points to two

completed tractor units have been blocked to traffic. Additional mitigation is unknown.

In section 12, T23S, R6W (Flagler Canyon subbasin), two old unsurfaced haul roads and spurs have been opened to facilitate timber harvest operations. They are flat bladed and bermed on the side. Upon completion, these roads will be blocked and waterbarred.

Overall, cutslope ravel and erosion is not a major problem. There are definite problem stretches. A number of these are identified map 43 (Appendix 1, Soil's Report). The worst situation and possibly the most common problem appears to involve a weakly cohesive fine sandy loam over brittle, weakly cohesive sandstone. Some of these problem stretches would be good candidates for hydromulching and seeding.

Many new road and in-unit landslides were anticipated when the field work began on this watershed analysis due to the protracted rainstorms which occurred in the region this past winter. However, unlike some other areas in the Tyee R.A., few landslide events were noted. In general, mass wasting and erosion of roads are currently well below historic highs. Even so, roads in the WAU are probably the largest source of sediment. Map 43 (Appendix 1, Soil's Report) highlights road segments identified as having problems warranting concern. A brief description of these problems are listed in Appendix 1, Soil's Report.

Effective freeze-thaw action, which can help break up compaction, is lacking in the Coast Range. Consequently the significant compaction can persist for 40 years or more. Because of the extensive network of roads and trails, both old and new, and the common practice of loggers choice yarding, long-term forest productivity losses due to soil compaction are likely significant and widespread throughout the BHY WAU.

The extensive network of roads and trails, both old and new, have likely altered the hydrology significantly in the BHY WAU by capturing, concentrating and redirecting surface and subsurface drainage. Soil compaction helps this process. One negative aspect can be the greatly increased delivery of water to streams during runoff periods, causing problems such

as stream bank erosion and higher flows. Another negative effect can be the decreased ground water delivery to the streams during the dry season.

In the parts of the WAU where the land is utilized for agriculture and grazing, roads, trails, and general compaction would likely have the same negative effects on the hydrology. Many of these lands which were naturally in forest were probably cleared in a way that was significantly compacting. Many of the subsequent agricultural and range management might also contribute to this alteration of hydrology (examples: artificial drainage, dense plow layers, livestock compaction, loss of topsoil).

IV.6 What is the current condition of connectivity within and between watersheds and what can be done to improve it?

To improve habitat for the northern spotted owl will require that we improve its availability and distribution in the Yoncalla drainage; thereby, greatly improving the bird's ability to disperse between the Coast Range and Cascade Province. This idea is not designed to create independent sites or territories in the valley but to provide stepping stones between the two provinces. The recommendation is to acquire five patches of forested habitat between Drain and Yoncalla and manage them in the long term as connectivity (dispersal habitat to early suitable habitat) (Figure IV.2, Table IV.2). Acquisition should be prioritized to maximize the earliest benefit to the owl.

Table IV.2. Possible acquisitions that would facilitate spotted owl connectivity between the Coast Range and the Cascades.

Township-Range	Section	Size (ac.)	Priority
Township 22 S, Range 06 W	23	80	5th
	24	160	5th
	25	140	3rd
Township 22 S, Range 05 W	19	40	2nd
	27	400	1st
	29	80	4th
	30	160	2nd
Total		1060	

IV.7 What special status plants (SSP's) are known to occur, or have the potential to occur within the analysis area?

IV.7.1 Current Condition

For clarity, use of the term Special Status Plant in this report will include the following vascular and non-vascular plants:

- (1) Federal Candidates (FC1 or FC2) for listing under the Endangered Species Act.
- (2) Bureau Sensitive (BS), Tracking Species (TS), and Assessment Species (AS).
- (3) Survey and Manage Species (Categories 1 through 4).
- (4) Protection Buffer Species.
- (5) Noxious Weeds.

- (1) Within the Yoncalla Watershed Analysis Unit, there are two recorded sites of Plagiobothrys hirtus var. hirtus, a FC1 plant that is also listed as Endangered by the State of Oregon. The habitat of this plant consists of moist or boggy meadows at elevations below 500 feet. Its occurrence is highly correlated with the presence of black mud. The two recorded sites of this plant are located on private lands (T22-R5-S28, T23-R5-S15). This plant is a narrow endemic to the Umpqua Basin. Soil maps indicate that there are approximately 500 acres total in the Yoncalla and Hayhurst Valley Watershed Analysis Units that exhibit the type of soil required by this plant. Surveys of the majority of this habitat were conducted by field staff from the Nature Conservancy in 1989; no additional sites were located.
- (2) There are no known sites of BS or AS species in the analysis area. There are numerous sites of Dichelostemma ida-maia, a Tracking Species, scattered throughout the analysis area. The habitat of this plant includes open woods and grassy slopes and meadows at elevations between 1000 and 4000 feet. All sites in the analysis area are located in areas subjected to natural or human disturbance, particularly on roadcuts, in clearcuts, and in areas impacted by fire. The plant appears to be an early successional species, although there is no research or monitoring data to validate this assumption. This is the only TS species known to occur in the analysis area.

Surveys for vascular plants in the analysis area have been conducted since approximately 1986, and have been focused primarily on timber sales and roads within the analysis area. Table IV.3 illustrates the number of acres (and the correlated percentage of the landscape) of each subbasin surveyed for vascular plants. Information presented in Table IV.3 was gathered from ARCVIEW, by identifying forest stands that are currently equal to or less than 9 years of age. Subbasins not listed in Table IV.3 had no information available.

Table IV.3. Number of acres surveyed for vascular plants in BHY WAU.

Basin/Subbasin Name	Acres Surveyed	Percent of Landscape
<u>Brush Crk. WAU</u>	803 (total)	5.3 (total)
Elk Overpass	68	4.1
Lower Thistle	92	7.4
Thistleburn	189	6.3
Squaw Brush	83	3.3
Lower Brush	2	0.1
Blue Brush	369	8.8
<u>Hayhurst Valley WAU</u>	466 (total)	2.8 (total)
Bear Lake	122	4.2
Andrews Crk.	231	6.1
Flagler Canyon	107	3.6
Billy Crk.	6	0.1
<u>Yoncalla WAU</u>	240 (total)	1.3 (total)
Devore Mtn.	148	3.1
Huntington Crk.	93	3.2

It should be noted that the list of State and Bureau Special Status Species has changed since 1986, with species being both added and removed. Therefore the acreages and percentages presented are not entirely accurate for plants added to the list in the past 5 to 10 years.

The following Special Status Vascular Plants are suspected to occur within the analysis area:

<u>Species</u>	<u>Status</u>	<u>Habitat Type</u>
<u>Asplenium septentrionale</u>	AS	Rock outcrop
<u>Aster vialis</u>	FC2	Meadow
<u>Astragalus umbraticus</u>	AS	Forest
<u>Botrychium virginianum</u>	TS	Forest, Meadow
<u>Cicendia quadrangularis</u>	AS	Meadow
<u>Cimicifuga elata</u>	FC2	Forest, Meadow
<u>Cypripedium californicum</u>	TS	Forest
<u>Cypripedium fasciculatum</u>	FC2	Forest
<u>Cypripedium montanum</u>	TS	Forest, Meadow
<u>Eschscholzia caespitosa</u>	AS	Forest, Meadow
<u>Horkelia congesta</u> var. <u>congesta</u>	FC2	Forest, Meadow
<u>Iliamna latibracteata</u>	AS	Riparian
<u>Lewisia cotyledon</u> var. <u>howellii</u>	FC2	Rock Outcrop
<u>Limnanthes gracilis</u> var. <u>gracilis</u>	FC2	Meadow
<u>Lupinus sulphureus</u> var. <u>kincaidii</u>	FC2	Forest, Meadow
<u>Mimulus tricolor</u>	AS	Meadow
<u>Montia howellii</u>	FC2	Rock Outcrop
<u>Pellaea andromedaefolia</u>	AS	Rock Outcrop
<u>Perideridia erythrorhiza</u>	FC2	Meadow
<u>Perideridia howellii</u>	AS	Meadow
<u>Phacelia verna</u>	AS	Rock Outcrop
<u>Polystichum californicum</u>	AS	Rock Outcrop
<u>Romanzoffia thompsonii</u>	BS	Rock Outcrop
<u>Sedum spathulifolium</u> var. <u>purdyi</u>	AS	Rock Outcrop
<u>Sidalcea cusickii</u>	TS	Meadow

<u>Sisyrinchium hitchcockii</u>	TS	Meadow
<u>Utricularia gibba</u>	AS	Aquatic
<u>Utricularia minor</u>	AS	Aquatic
<u>Wolffia columbiana</u>	AS	Aquatic
<u>Wolffia punctata</u>	AS	Aquatic

In addition to the four identified habitat types noted above, the occurrence of vascular SSP's is often correlated to riparian areas, where available soil moisture and levels of humidity are more amenable to the growth of plants. Many of the SSP's noted above are somewhat more likely to occur in less disturbed conditions, such as older timber stands or ungrazed meadows. This, however, does not indicate that these plants would not occur in areas that have been subject to past disturbance, such as old jeep trails or second growth timber stands.

- (3) There are no recorded known sites of Survey and Manage Species (Categories 1 through 4) in the analysis area. No surveys for these species have been conducted to date. Surveys for these species are expected to begin in 1996, and will likely be limited to areas proposed for management actions. The occurrence of these taxa is positively correlated to older timber stands, although their distribution throughout a variety of disturbed habitat has been documented. It is anticipated that a number of the lichens, mosses, and fungi listed in Appendix H, Table H-1, of the Roseburg District ROD/RMP occur in the analysis area. Retention tree selection and grouping, the level of soil disturbance, and the use of prescribed fire in future forest stand management activities will greatly influence the distribution or survival of these taxa within the analysis area and beyond.
- (4) There are no recorded known sites of Protection Buffer Species in the analysis area. No surveys for these species have been conducted to date. Surveys for these species are expected to begin in 1996, and will likely be limited to areas proposed for management actions. The occurrence of these taxa is positively correlated to older

timber stands, although their distribution throughout a variety of disturbed habitat has been documented. It is anticipated that a number of the mosses and fungi listed in Appendix H, Table H-2, of the Roseburg District ROD/RMP occur in the analysis area. Retention tree selection and grouping, the level of soil disturbance, and the use of prescribed fire in future forest stand management activities will greatly influence the distribution or survival of these taxa within the analysis area and beyond.

- (5) Although an intensive survey for noxious weeds in the analysis area has not been completed, it is recognized that noxious weeds are distributed throughout the analysis area in varying densities. Plants in this group are most commonly found in areas subjected to human disturbance, i.e. roadsides, road medians, clearcuts, quarry and stockpile sites, grazing land. Noxious weeds suspected to occur or actually observed in the analysis area include Scotch Broom, Tansy Ragwort, St. Johnswort, Canada Thistle, Italian Thistle, Bull Thistle, Yellow Starthistle, Rush Skeletonweed, and Gorse. Attempts to control and/or prevent the spread of these species will likely continue by private landowners, the BLM, and the Oregon State Department of Agriculture, by utilizing chemical, manual, and biological control methods.

V. CULTURAL

Desired Future Condition:

To provide a safe and healthy environment in which to work and recreate while maintaining the cultural, historical, and environmental values of the watershed in cooperation with adjacent landowners, the local community, and other government agencies and groups.

V.1 Environmental and safety hazards

Checks with the Oregon Department of Environmental Quality reviewed no known sites considered to constitute a hazard to people or the environment within the analysis area. A check of BLM records identify an abandoned automobile and camper shell in the Hayhurst Valley area.

Potential sources of environmental contamination include any spills/releases of toxic materials that may occur at the Douglas County Transfer Site in T22S-R5W-s33, accidents and spills involving toxic materials along the railroad and I-5 corridors in the Yoncalla WAU, and accidents and spills involving toxic materials along the other state and federal routes throughout the analysis area. Other sources of environmental contaminations include disposal of chemicals and contaminated materials from illegal drug labs, the illegal dumping of trash and chemical (both household and industrial), and accidental spills/releases from industrial/agricultural sites throughout the area.

V.2 Public Involvement

A multi-year cooperative project is ongoing in the Brush Creek WAU. This project is designed to gather baseline information on stream conditions, assess impacts attributable to streamside logging completed in accordance to the new Oregon's Forest Practice Act, and improve fish and streamside habitats. Major partners in this project are the BLM, Lone

Rock Timber Company, Oregon Department of Forestry, and the Oregon Department of Fish and Wildlife. Major undertakings of this group include: stream temperature monitoring, fish occurrence surveys, spawning surveys, fish habitat assessments, construction of instream structures, riparian restoration, and smolt counts. Contributions of monies, manpower, and equipment are in excess of \$ 100,000.00.

The other large scale cooperative project being undertaken is the Umpqua Basin Fisheries Initiative. Cooperating in this project are federal and state natural resource management agencies, Douglas County, and several large, private landowners. The primary concern of this effort is to protect and restore the anadromous fisheries of the Umpqua Basin. Major efforts have been undertaken to assess fish habitat conditions, conduct spawning surveys, and to document fish production.

Monies for natural resource management on public and private lands are available in the form of grants and matching funds from many sources; Rocky Mountain Elk Foundation, National Wildlife Turkey Federation, and Ducks Unlimited are some of the more well known sources. The BLM is always open to working with private landowners for the betterment of natural resource management.

V.3 Recreation

Recreation in the BHY WAU is primarily of a dispersed nature. Hunting is the primary activity. Other recreational activities include: shooting, fishing, off highway vehicle use, mountain biking, and forest collecting.

There are no immediate recreation needs identified for the area. Opportunities for acquiring suitable areas for watchable wildlife sites and day use facilities are in the long range plans.

V.4 Historical/Cultural

Prior to white settlement this analysis area was occupied by two groups of Native Americans. The Yoncallas inhabited the eastern portion of the BHY WAU and the Lower Umquas (or Kalawatsets) inhabited the western portions closest to the Umpqua River. The first permanent white settlement in the area occurred just to the west of the analysis area when the Hudson's Bay Company established a trading post at Fort Umpqua (near present day Elkton). Settlement began in the mid-1840s, as settlers spread up the Elk Creek Valley from Scottsburg and Elkton. Explorers, Levi Scott and Jesse Applegate, seeking better routes to the Willamette Valley traversed the Yoncalla area at that time. Robert Cowan and his family first settled in the Yoncalla area in 1848 and Jesse Applegate and family and Levi Scott settled into the area between 1849 and 1852.

The discovery of gold in California in 1849 accelerated the movement of people through the area and firmly established the Oregon and California Trail. In 1872 the Oregon and California railroad came through the area. The first paved road, the Pacific Highway (Highway 99) came into being in the 1920's, and continued to bring people through the Yoncalla Area.

There are no known sites of historical importance or of cultural importance to Native Americans documented on Federal lands within the analysis area. Although, there is a significant historical/Native American cultural site on private lands, in the Halo Creek compartment.

VI. WILDLIFE

VI.1 Affected Environment from a Wildlife Perspective:

The forest stands in the combined drainage have the following seral stage distribution:

<u>Age</u>	<u># Patches</u>	<u>Acres</u>	<u>Association</u>
0-5	20	493	grass/forb
6-14	45	1,396	shrub
15-24	29	972	open sapling/pole
25-74	71	2,109	small sawtimber
75-114	31	1,423	large sawtimber
115-194	39	2,632	young old-growth
195+	38	2,293	old-growth.

Within the BHY WAU there are 61 ecologically distinct patches of older age habitat (i.e. equal to or greater than 75 years of age), with the following patch size distribution:

<u>Patch Size (acres)</u>	<u>Number of Patches</u>	<u>Average acreage</u>
5-26	18	15.4
27-64	20	46.4
65-100	7	85.0
101-250	10	137.7
251-600	5	381.2
601+	1	1,058.0

VI.2 Desired Future Condition

To maintain and enhance the quality of wildlife habitat for native species.

VI.3 Key Questions

1. What is the current distribution and abundance of special status species, neotropical birds, game animals, and critical habitats?

2. What are the habitat variables that are influencing the quality of special status species, neotropical birds, game animal habitats and critical habitats?
3. What management actions can be recommended to improve or enhance special status species, neotropical birds, game animal habitats and critical habitats?

VI.4 Current Distribution and Abundance

Within the drainage there are approximately 1,423 acres of category 2 habitat (i.e. foraging and roosting) and 4,925 acres of category 1 habitat (i.e. nesting, foraging, and roosting habitat) available for the northern spotted owl. There are six known owl sites within the drainage and they should be managed within the guidelines of the President's forest plan (ROD - April 1994), and their distribution are as follows:

Site Name	Master Site #	<u>Occupancy/Reproduction:</u>				
		91	92	93	94	95
Deadman Butte	0267A	S-N	P-Y-2	P-N	P-N	V
Hancock Creek	1816A	P-N	P-N	P-N	P-Y-1	P-Y-1
Middle Ridge	0390A	V	P-N	S-N	V	V
Squaw Creek	0514	P-N	P-Y-1	P-Y-1	P-Y-2	P-N
Squaw Trib	2201	P-N	P-Y-1	P-N	P-N	P-N
Thistleburn Cr	0266	P-Y-1	P-Y-2	U	S-N	P-Y-2

(Pair status: P=pair, S=single, U=unknown, V=vacant)

(Nesting status: Y=yes, N=no; #=number of juveniles)

Within the drainage there are 7,882 acres of designated critical habitat for the northern spotted owl and 5,968 acres of proposed critical habitat for the marbled murrelet. These areas should be managed in a manner that does not adversely modified its potential use for both the owl and the murrelet.

There are approximately 6,348 acres of suitable marbled murrelet habitat within the drainage. During the 1993-4 breeding season, five marbled murrelet survey sites were established in the drainage following the protocol of Ralph et al. (1993). The survey sites (Andrews Overlook, Upper Brush, Upper Andrews, Northern Blue, and Blue Hole MAMU intensive survey sites) are located in T23S, R06W, sections 9 and 17. During two years of survey no murrelets were detected during the 1993-4 breeding seasons.

VI.5 Habitat Variables

Within the drainage the major habitat variables that influence the utility of the land for the spotted owl and the marbled murrelet are age, structure, availability, and fragmentation of suitable habitat.

The major limiting factor for big game is the quality and quantity of foraging habitat in the drainage.

The neotropical bird community in the late-successional habitat is limited by the distribution and availability 3-tiered stands (three layered canopy) and the distribution, availability, and the development of the shrubby/brushy habitat in the lower canopy.

VI.6 Management Actions

Prior to initiation of any proposed actions, such as a ground disturbance activity or one that is extremely noisy, within a quarter of a mile of suitable marbled murrelet habitat, we need to either seasonally restrict (i.e. those actions that are too noisy) or survey all potential murrelet habitat to protocol standards and determine the level of avian activity at the site(s) -- -- absence/detections observed/occupied (see protocol and definitions developed by Ralph et al. 1993).

To improve habitat for big game in the drainage would require increase use of underplanting

and road-side planting of grasses and legumes. Although, the implementation of this idea is a low priority it could be implemented during the normal road maintenance and construction activities.

To improve habitat for the marbled murrelet we need to reduce, and where possible, eliminate the effects of fragmentation on the bird and its ability to reproduce. The latter concept is in the earlier stages of development, therefore I have at this time no specific recommendation(s) other than buffering potential suitable habitat where possible with large trees where as possible.

To improve habitat for the neotropical birds in the drainage requires that we promote an equitable distribution of dense brushy and shrubby vegetation in both the upland and riparian habitats.

VII. MANAGEMENT RECOMMENDATIONS

VII.1 Data Needs

VII.1.1 Hydrology

Prior to implementation of any project which would result in ground disturbing activities, the following data should be collected within the general project area.

1. Identify roads or adjacent ditches that collect precipitation which flow directly into stream channels. Prescribe specific methods to modify the drainage network to reduce peak flow delivery of water.
2. Complete a culvert inventory. Note size, number, spacing, and condition of culverts. In particular, identify site specific road networks requiring increased cross drainage, culvert upgrading, or need for culvert maintenance.
3. Identify either hardwood dominated or young conifer stands on federal land adjacent to perennial streams. Inventory these stands to determine the potential for silvicultural treatments (such as conifer restoration, density management, brushing, etc.) to speed the attainment of a coniferous, late-successional riparian reserve.
4. Conduct a thorough fish distribution survey in all streams, including intermittents, to determine presence/absence of coho salmon and cutthroat trout.

VII.1.2 Cumulative Effects Analysis

The following procedures may be utilized as a basis to trigger more intensive data collection within a given watershed analysis unit:

1. Determine impacts to the transient snow zone. If a high percentage of the land within the transient snow zone is in a nonvegetated state, look for downstream indications of negative impact of peak flows.

2. Calculate the equivalent clearcut area index. If the percentage of "non-recovered" area is "high", consider intensifying stream channel, aquatic habitat, and riparian condition inventories.

3. Review the Oregon DEQ data related to water quality data. If an streams in the watershed are identified as "water quality limited", identify potential federal contribution to the problem and generate site specific recommendations for mitigation or recovery.

VII.2 Management Recommendations

VII.2.1 Vegetative Management

Table VII.1. Forest area available for forest management opportunities in the BHY WAU.							
Land Use Allocation ¹	Density Management ² (acres)				Regeneration Harvest ³ (acres)		Pre-commercial thinning ⁴ (acres)
	GFMA	CONN	LSR1	LSR2	GFMA	CONN	
Brush Creek	448	0	7.5	512	554	0	666
Hayhurst Valley	752	129	0	58	381	91	422
Yoncalla	6	23	0	2	166	116	225
Total	1,206	152	8	572	1,101 [‡]	207	1,313
¹ GFMA = General Forest Management Area; CONN = Connectivity Area; LSR1 = Mapped Late Successional Reserves; LSR2 = Unmapped Late Successional Reserves- element 2. ² Density management may occur in stands up to 80 years of age in the GFMA and 120 years of age in the CONN. ³ Minimum harvest age is 60 years in GFMA and 100 years in CONN. ⁴ Precommercial thinning may occur in stands up to 20 years of age. [‡] Includes the planned Broken Buck T.S.							

Old Growth Restoration --

Possible treatments include: 1) thinning the overstory to produce large trees, release advanced regeneration, hardwoods, or other plants; or reduce risk from fire, insects, diseases, or other environmental variables; 2) underplanting, and limiting understory vegetation control to begin development of multistory stands; 3) snag and coarse woody debris creation; 4) reforestation; and 5) use of prescribed fire.

Density management is a useful tool in aiding and accelerating the development of late-successional and old-growth characteristics within a forest stand. These characteristics include large diameter trees, multiple canopies, multiple tree species, large diameter snags and coarse woody debris, and presence of decay and defect in the stand. "Thinning prescriptions should encourage development of diverse stands... (USDA and USDI 1994:B-6)". There are 1920 acres of forest land less than 80 years of age that could be suitable for some form of density management. Of those 1920 acres, 958 acres are less than 20 years of age.

All projects must also meet the intent of the Aquatic Conservation Strategy (USDA and USDI 1994) and not retard or prevent its attainment.

Riparian -- Convert selective riparian hardwood areas to conifer, thin stands of conifer in riparian reserves and pull large trees into stream (specific sites and trees to be determined) to enhance/speed up the attainment and recruitment of LWD

Fertilization -- There are approximately 1845 acres of forest that would benefit from the application of nitrogenous fertilizers. A conservative estimate of riparian reserve areas in those stands would be about 50 percent. This would result in 923 acres that could be fertilized. (No fertilization has occurred on Federal lands in the past, within the BHY WAU.)

Pruning -- A preliminary search of the M*S database identified approximately 150 acres that are potentially ready for pruning. No pruning would occur in riparian reserves or LSR.

Regeneration Harvest -- Regeneration harvest and forest management aimed at developing commercially harvestable stands will occur on Matrix lands. Standards and guidelines specific to matrix lands are listed on page C-39 of USDA and USDI (1994). Commercially oriented, forest management may include the following components: commercial harvest using aerial, cable, and/or ground based systems; slash treatments, such as burning or piling;

planting a species mix of genetically superior seedlings, suppression of competing vegetation; precommercial thinning and commercial thinning; and fire suppression.

VII.2.3 Fisheries

- Defer placement of any in-stream structures (cabled logs, root wads and boulders) for the next 2-5 years until the results of ODFW's efforts on private lands are known.
- Create more pool areas and greater residual pool depths; allow beavers to build and maintain their dams.
- Place gravel in selected sites (i.e. ¼-1 inch diameter in upper reaches for CTT; 1-4 inch diameter in lower reaches for Coho).
- In the Yoncalla Watershed promote private landowners to fence streambanks and plant buffer zones, in cooperation with other agencies (ODFW, NRCS, Douglas County, etc.).

VII.2.4 Roads and Culverts

- Replace the two culverts on BLM road 22-7-14.1 at the unmarked, unnamed tributary in T22S-R6W, Section 8, with its headwaters on the north side of Blue Buck Mountain in Section 17. Provide fish passage to and from Brush Creek.
- Replace all culverts (at least 25) which are undersized, rusted out, and/or plugged up, and clean and realign drainage ditches on BLM road 22-7-24.0 along Thistleburn Creek.
- Replace and or install culverts, at least 7 sites, which are undersized, rusted out, plugged up or absent, and clean and realign drainage ditches on BLM road 23-6-6.2 along Blue Hole Creek.
- Replace all culverts, at least 7 sites, which are undersized, rusted out, plugged up or misaligned on BLM Road 23-6-2.0 along Andrews Creek.
- Obliterate or upgrade the section of BLM road 23-6-6.2 along Blue Hole Creek above the junction with BLM road 23-6-18.1 to restore and protect the headwaters area.
- Obliterate or upgrade BLM road 23-6-6.0 above BLM road 22-6-31.2 along Squaw Creek and BLM road 22-6-31.1 in LSR. Place gate on BLM road 23-6-6.0 below BLM road 22-6-31.0 and close roads from 1 October to 31 April.

The following roads need to be examined for possible repair/renovation/closure. Where possible these opportunities should be examined for inclusion with adjacent forest management activities.

1. BLM road 22-6-19.0: Steep graded road with disrupted drainage traveling down road surface causing bad rilling. (Thistleburn)
2. BLM road 23-6-18.1: Steep graded road with disrupted drainage traveling down road surface causing bad erosion. (Blue Brush)
3. BLM road 22-5-5.0: Slump caused 50 feet section of road to sink 1-1/2 feet. Also rockfall colluvium buried ditch near intersection with 22-5-33.0 road. (Billy Creek)
4. Skid trail off of BLM road 22-6-33.1: Very steep graded, entrenched, and eroding. (Thistleburn)
5. BLM spur road in the S1/2 SW1/4 Section 33, T22S, R6W (feeds into the 22-7-24.0 road to the south): Shallow rilling in roadbed; cutslopes are bare. (Squaw Brush)
6. BLM spur 23-6-14.0 road: The latter part is unrocked, getting occasional traffic and experiencing some shallow rilling. Grass covers about 60 Percent of surface. The first part of the road where rocked has bare, eroding cutslopes. (Flagler Canyon)
7. BLM spur 23-6-13.0: Gets occasional traffic and in one stretch where the grade is steep are erosion ruts over one foot deep and vegetation is lacking. (Flagler Canyon)
8. Road on BLM and Private Surface near Deadman Butte NW1/4, NE1/4 SE1/4, NE1/4 SW1/4, S1/2 NW1/4 Section 30, T22S, R6W. Rill erosion (Thistleburn, Lower Brush)
9. BLM road 22-6-29.0 due to rockfall. (Thistleburn)
10. BLM road 22-6-32.1 due to rockfall and colluvial ravel; hydromulch candidate. (Thistleburn)
11. BLM roads 22-6-33.0 and 33.1 due to sheet erosion and rilling and colluvial ravel; hydromulch candidates. (Thistleburn)
12. BLM road 22-7-24.0 in the S 1/2 Section 33, T22S, R6W due to series of small failures; some cutslopes bare. (Thistleburn)
13. BLM road 22-6-19.1 in Sections 19 and 30, T22S, R6W due to small cutslope failures and colluvial ravel. (Thistleburn)

14. BLM road 23-6-17.2 due to colluvial ravel of low cohesion soil and soft, fractured siltstone. (Blue Brush)
15. BLM road 23-6-22.0 due to colluvial ravel in soft, brittle sandstone and siltstone. (Blue Brush)
16. Short stretches of the BLM road 23-6-8.1. (Blue Brush)
17. BLM road 23-6-10.3 due to segments having bare cutbanks and sloughing. (Andrews Creek)
18. BLM road 23-6-10.3 due to large cutslope failure. (Andrews Creek)
19. BLM road 23-6-11.1 due to erosion and colluvial ravel in highly fractured siltstone. (Flagler Canyon)
20. BLM road 23-6-14.0 due to one segment having sheet erosion on bare cutslopes; candidate for hydromulching. (Flagler Canyon)
21. BLM road 22-6-23.0 due to bare cutslopes in deep clayey soils; candidate for hydromulching. (Bear Lake)
22. BLM road 22-6-22.1 due to bare cutslopes in deep, clayey soils; candidate for hydromulching.
23. BLM road 22-5-33.1 due to nearly bare cutslopes and shallow colluvial ravel against rock cutbanks. (Devore Mountain)
24. BLM road 23-5-19.0 due to small cutslope failures and colluvial ravel filling ditches. (Huntington Creek)
25. Investigate obliterating roads in T23S-R5W, section 19.
26. BLM road 32-6-2.0 due to earth flow (scarp) undermining outside portion of road, in the NE/4 NW/4 of section 15, T23S R6W.

VII.2.5 Riparian Reserves

- Fully protect the headwaters area of Flagler Creek with full riparian buffers in Connectivity block, T23S-R5W, Section 19.
- Fully protect the headwaters area of Billy Creek, South Fork, Middle Canyon and Five Point Canyon with full riparian buffers, T23S-R6W, Sections 13 (GFMA) and 14 (LSR).

VII.2.5 Riparian Reserves

- In unique circumstances, the Riparian Reserve boundary may actually extend beyond the ridge-top that defines the catchment for a given hydrologic feature (e.g., watershed, sub-watershed, drainage). In situations where this occurs, activities that are proposed along the ridge-top that would technically occur within the Riparian Reserve boundary should be evaluated in the appropriate NEPA document to assess whether the proposed activity would hinder or prevent attainment of ACS objectives. The level and detail of analysis should be commensurate with the type of activity being proposed.

- Fully protect the headwaters area of Halo Creek with full riparian buffers in Connectivity block, T22S-R5W, Section 25.
- Fully protect the headwaters area of Huntington Creek with full riparian buffers in Connectivity block, T23S-R5W, Section 19.

VII.2.6 Wildlife

To improve habitat for big game in the drainage, consider the increase use of underplanting and road-side planting of native grasses and legumes.

To improve habitat for the neotropical birds in the drainage requires that we promote an equitable distribution of dense brushy and shrubby vegetation in both the upland and riparian habitats.

The recommendation is to acquire five patches of forested habitat between Drain and Yoncalla and manage them in the long term as connectivity habitat for the dispersal of northern spotted owls and late-successional/interior forest, neotropical migrants (Refer to Table IV.2).

VII.3 Monitoring

A minimum of 20 percent of future land management projects conducted by the BLM should be considered for monitoring of the following criteria: sediment transport, streamflow, and pH.

Monitor channel conditions and evaluate the effects of the mean annual flood using a stream classification system.

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Figure I.1. Land use allocations within the BHY watershed analysis unit.

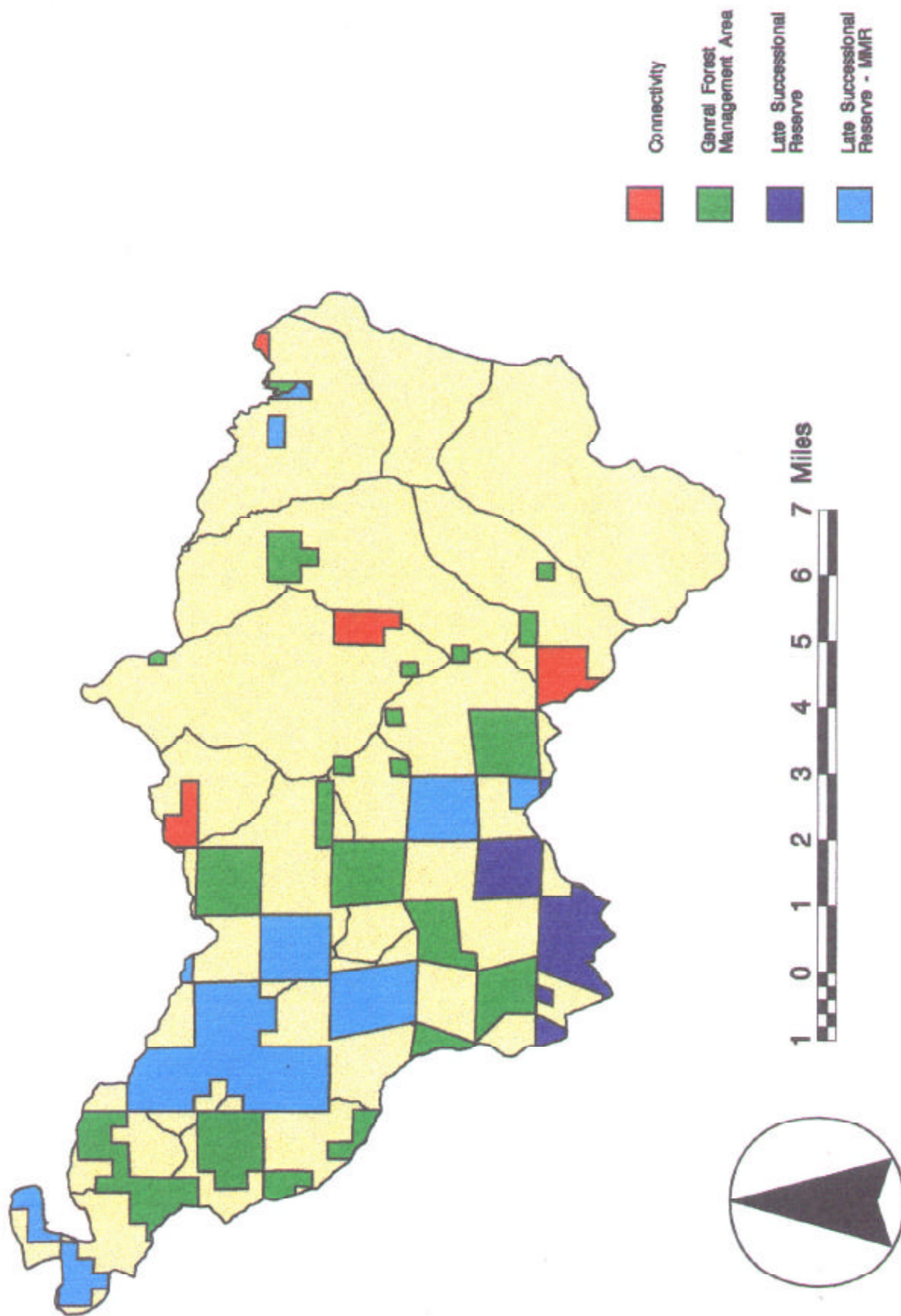
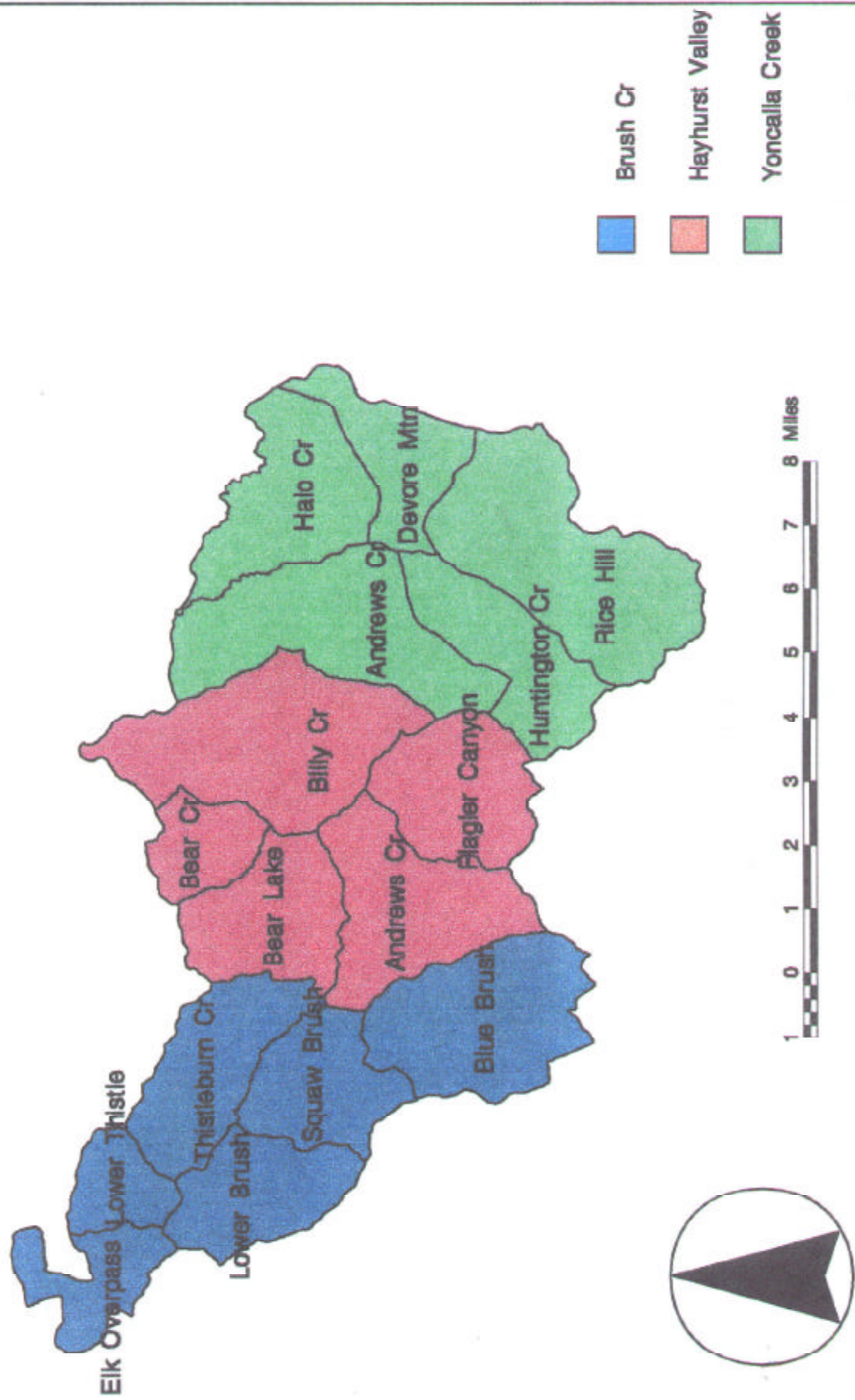


Figure 1.2. Watershed analysis units and compartments.



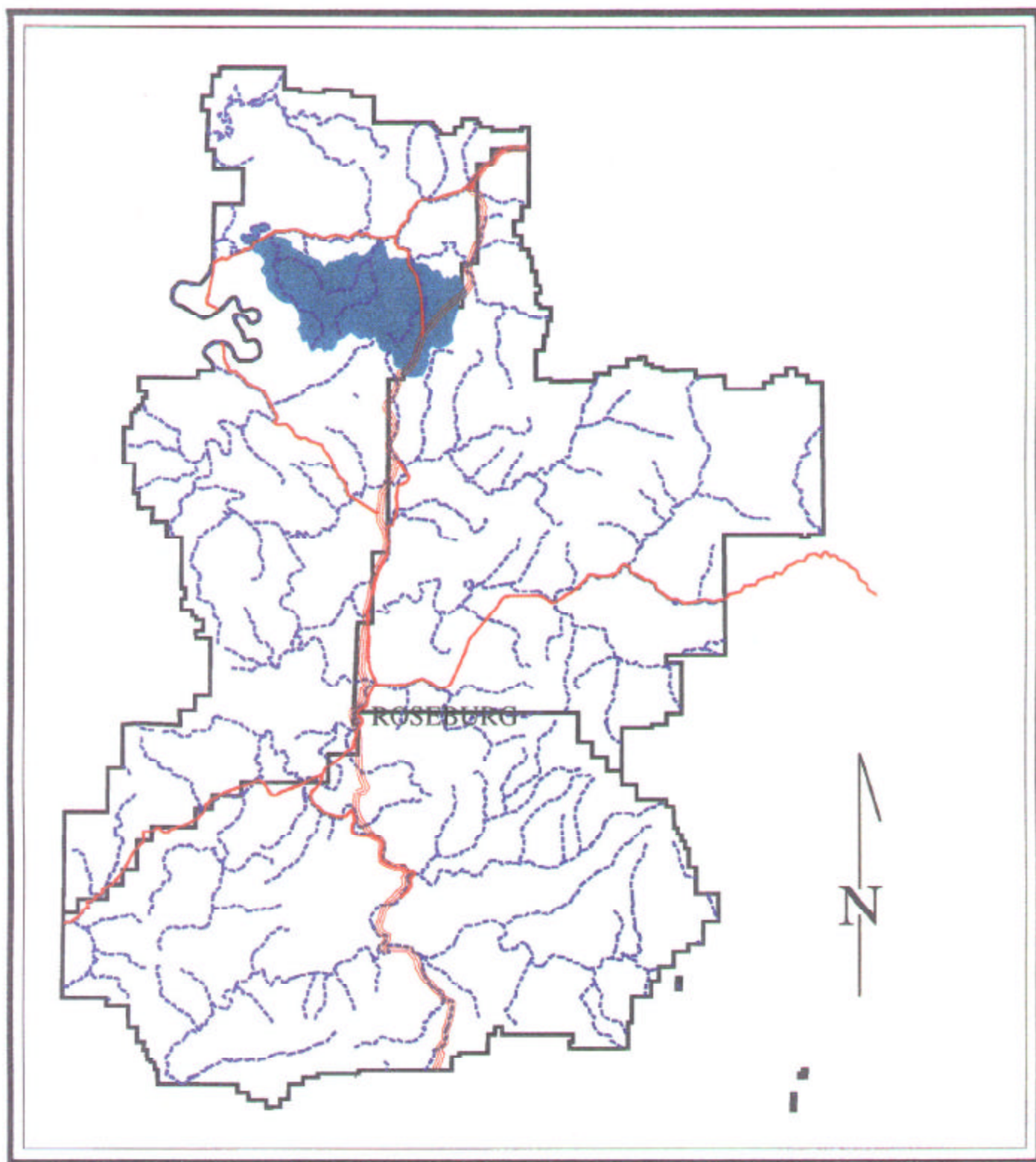


Figure 3.
Location of
BHY WAU.

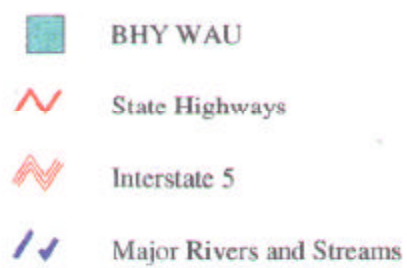
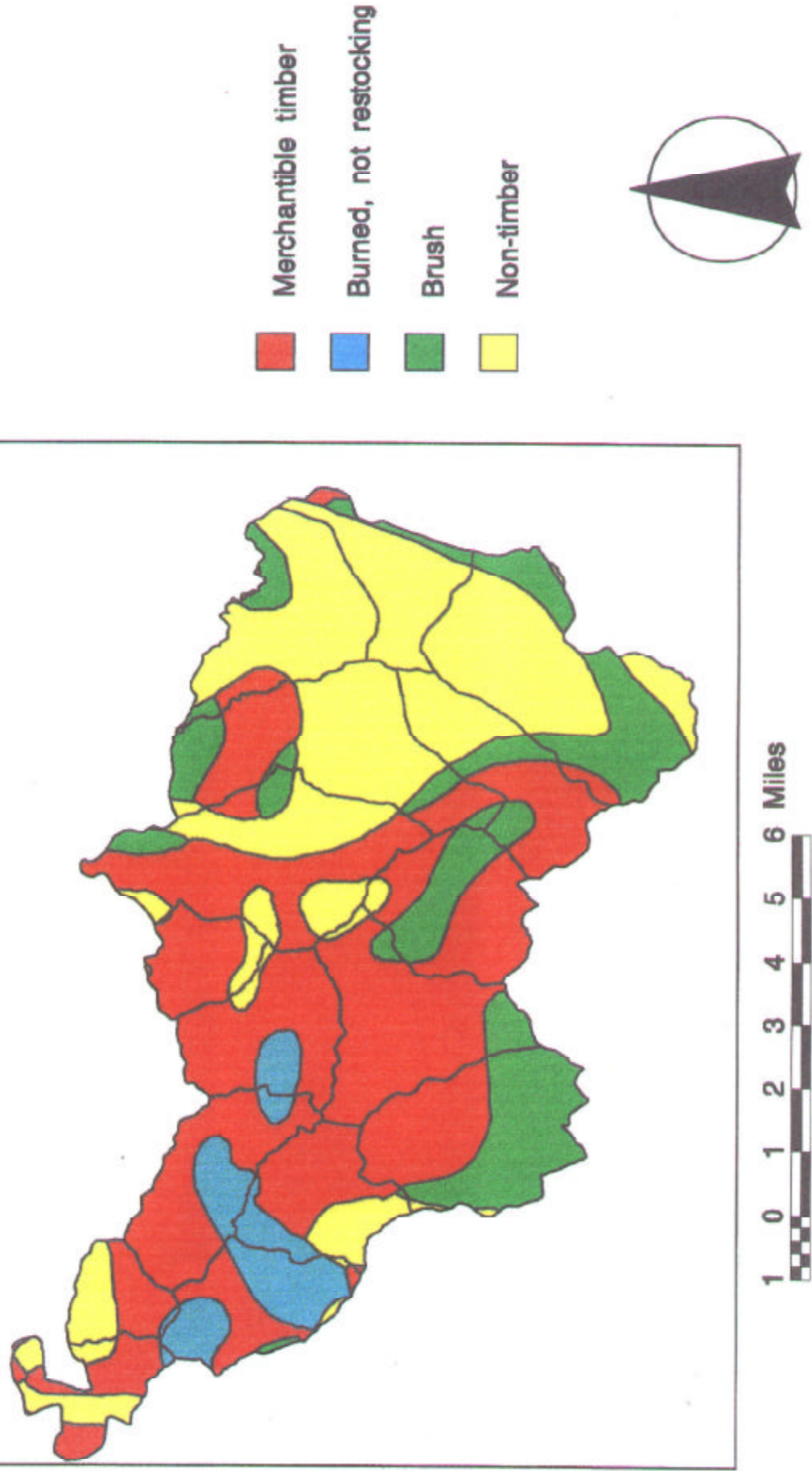


Figure I.4. 1914 Oregon state forest
type map within the BHY WAU.



TIMBER HARVESTING BHY WAU

Acres per Year

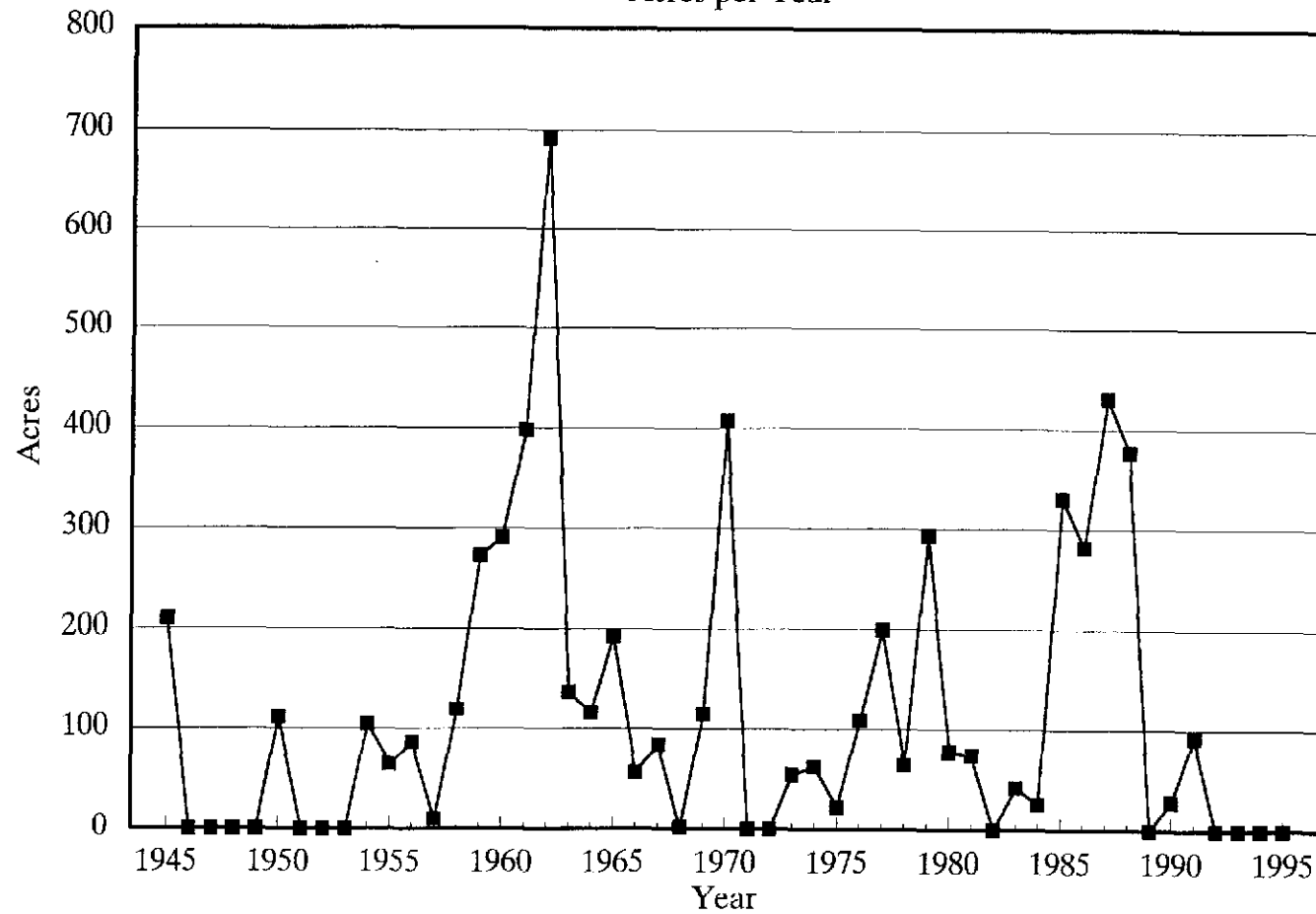


Figure IV.1

Figure IV.2. Possible acquisitions to facilitate dispersal between the Coast Range and the Cascades.

